THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 19 MARCH, 1940 Number 3

LEON J. HOUZE, SR., 1857–1940

For story, see pages 104–105

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Volume 19 **March, 1940** **Number 3**

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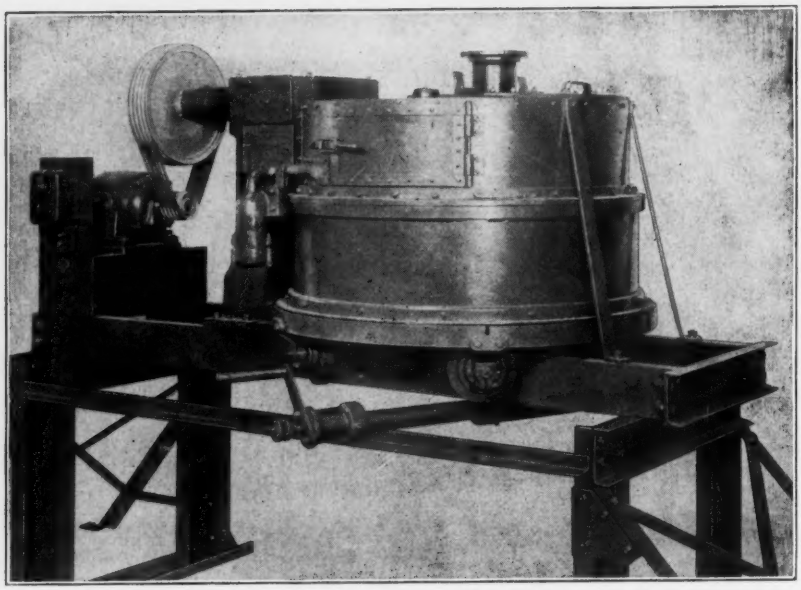

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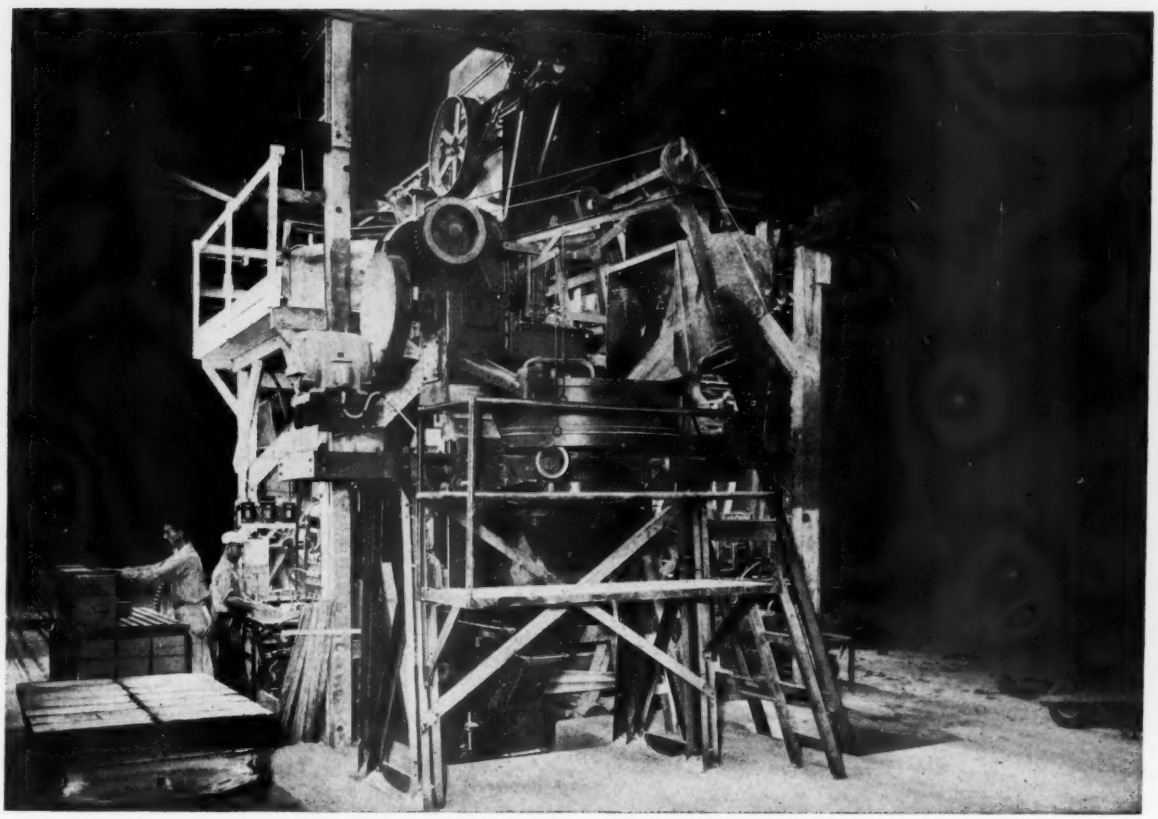

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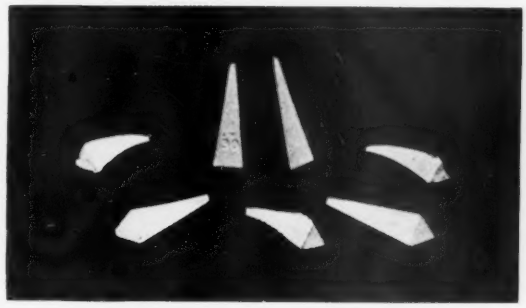

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The soft series: used chiefly for firing overglaze decoration on pottery and glass. Cones 022-011.

The low temperature series: used chiefly for firing red clay products and soft glazes. Cones 010-01.

The intermediate temperature series: used chiefly for buff and white clay products and the hard glazes. Cones 1-19.

The high temperature series: used chiefly for testing refractories. Cones 20-42.

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Applying this yardstick to all more or less complete Corhart furnaces on which we have records, we get a result of 61.8 tons per square foot of melting area per life. These figures cover a ten year period. During the past three or four years, however, the technique of operation and the proper application of refractories has naturally shown marked improvement. We would expect this improvement to reflect itself in a higher production factor, and we are not disappointed: The average of five recent Corhart furnaces shows 87.8 tons of glass per square foot per life—an increase of 42%.*

Our statistics gathered on non-Corhart furnaces over the past ten years show an average of 20.6 tons per square foot per life.* If we accept this figure and add 100% to allow for modern improvements in operating conditions and materials, we still find the non-Corhart tanks less than half as productive as the Corhart furnaces.

All of these figures represent average performances. We know of one furnace that contained Corhart only in the throat and doghouse, which produced 69 tons of clear flint glass per square foot during one life. But this, of course, is exceptional. Against that we can mention the exceptional figure of a Corhart furnace that went out last December after producing 117 tons per square foot during one life.

Compare your own results with these figures. We believe it will give you a very fair idea of the gain you could make, in life and production, by a fuller use of Corhart Electrocast. . . . Corhart Refractories Company, Incorporated, 16th and Lee Sts., Louisville, Ky. . . . *In Europe:* L'Electro Refractaire, Paris. *In Japan:* Asahi Glass Co., Tokio.

*All furnaces included in this compilation were melting clear flint glass for the production of container ware.

CORHART ELECTROCAST REFRACTORIES

A REPORT ON THREE INTERESTING TANKS

IN August of 1938 we suggested, on this page, that any reasonable comparison of life and output of different glass furnaces requires *a Common Denominator.* This Common Denominator was suggested to be *the output* (in tons of glass) *per each square foot of melting area, per life.*

At that time we showed that the average output for five typical Corhart furnaces was 87.8 tons of glass per square foot per life.

We believe that the glass industry will agree that an average performance of 87.8 is indeed very good. But as our customers' experience with Corhart Electrocast increases, even this high average of eighteen months ago is being steadily raised. For instance, we have just received some rather impressive data from three furnaces which are still operating in the plants of two different companies. Repairs are not expected before the summer of 1940, in any case. One of these furnaces has already produced 127.4 tons per square foot of melting area, while the corresponding figures for tanks number two and three are 95 and 117, respectively. The tabulation below shows this data.

Furnace	Average Square Foot Rating	Total Production in Tons Per Square Foot of Melting Area	Life To Date In Days
Number 1	5.26	127.4	710
Number 2	6.76	95.0	673
Number 3	6.51	117.0	816

We suggest that you might find great interest and profit, by making your own comparisons, of your own tanks, with the figures above.

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A Monthly Publication Devoted to Proceedings of The Society and Promotion of Coöperative Research of Technical, Scientific, and Art Questions

Volume 19 **MARCH, 1940** **Number 3**

PAPERS

FACTORS AFFECTING PHYSICAL PROPERTIES OF A DRY-MIXED BODY*

By Carl H. Rapp

Abstract

The effect of (1) mixing time, (2) order of addition of ingredients in compounding the mixture, and (3) use of sodium silicate and acetic acid in the tempering water on the physical properties of an electrical porcelain body is discussed. Such properties as water absorption, apparent specific gravity, shrinkage, and modulus of rupture are also considered.

I. Introduction

The economic advantages of the wet-pan process in the preparation of whiteware bodies in recent years have been advanced by the users and manufacturers of such equipment. Fix[1] has presented a résumé of dry mixing, and Meeker[2] has discussed the application of dry mixing before the preparation of dinnerware bodies by the plastic process.

The present work deals with the application of the wet-pan type mixer to the plastic preparation of a flint-feldspar-clay body of the electrical porcelain type. The influence of various factors, such as mixing time, sequence of compounding the mixture, and addition of sodium silicate in amounts sufficient to cause maximum deflocculation of the body in the slip state, and the effect of the addition of acetic acid on the physical properties of such a body are discussed.

II. Batch Preparation

The composition used for all test batches is shown in Table I.

Table I

Materials	(%)	Grain size
Del. kaolin	20.0	Air-floated
Fla. kaolin	20.0	" "
Ky. ball clay	7.5	" "
English ball clay	7.5	" "
Feldspar	15.0	10% on 325-mesh
Flint	30.0	1% on 325-mesh

Batches of 50 pounds each were mixed with 20.3% tempering water (percentage of water based on wet weight) containing "U" brand sodium silicate,† 22.6% when using water only, or 27.5% when using 300 cc. of glacial acetic acid in the water. Except for batches B-11, B-13, B-14, and B-15, the tempering water was added as a fine spray during the 5-minute mixing period.

Batch B-1 was prepared by dry-mixing the nonplastics for 2 minutes, followed by the addition of water; the clays were then added slowly during the first 5 minutes of a 10-minute wet-mix period. For batch B-2, the sequence of compounding was reversed, but the mixing time for B-1 was duplicated.

Batches B-3, B-4, and B-5 were made by using a 2-, 10-, and 20-minute dry-mix interval, respectively, followed by 10 minutes of wet mixing.

Batches B-6 and B-7 were made by using a 2-minute dry-mix period followed by a 5- or a 30-minute wet-mix period, respectively.

Batches B-8, B-9, and B-10 are duplicates of B-3, B-1, and B-2, respectively, except that the sodium silicate was added to the tempering water.

Batches B-11 and B-12 duplicate the sequence and time of B-3, except that in B-11 the ball clays were added as a slip deflocculated with sodium silicate and in B-12 a 50-minute wet-mix period and acetic acid in the tempering water were used.

For batch B-13, the water was poured in the mixer, followed by the addition of the nonplastics while mixing

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (White Wares Division). Received April 18, 1939.

[1] F. A. Fix, "Application of Dry Mixing in Whiteware and Refractory Industries," *Bull. Amer. Ceram. Soc.*, **17** [9] 351–54 (1938).

[2] R. C. Meeker, "Properties of Dinnerware Bodies Prepared by the Dry-Mix Method," *ibid.*, **17** [11] 435–36 (1938).

† 0.3% of sodium silicate based on dry weight was sufficient to cause maximum deflocculation of the body in the slip state having a specific gravity of 1.352 at 80°F.

for 4 minutes; the clays were then added slowly during 3 minutes of a 6-minute wet-mix period.

Batch B-15 is a repetition of B-13 with sodium silicate in the tempering water.

Batch B-14 was made by placing all materials and water in the mixer and wet-mixing for 10 minutes.

All batches were extruded into a 1-inch column from a vacuum pug mill evacuated to 27 inches of mercury. From this column, 7-inch modulus of rupture bars, 3-inch shrinkage test pieces marked with two fine circles on the circumference and spaced 2 inches apart, and 1-inch apparent specific-gravity pieces were cut. The test pieces were dried and fired to cone 14 through a butane-fired tunnel kiln on a 14-hour schedule.

III. Physical Property Tests

The percentage of water absorption was obtained by averaging five determinations on each batch by the usual method, using a balance accurate to 0.001 gram.

The apparent specific-gravity determinations were made on a Jolly balance; the results, which are averages from five specimens of each batch, have an accuracy of ± 0.003.

The shrinkage results are averages from ten specimens of each batch, using a measuring fixture accurate to 0.001 inch.

The dry and fired modulus of rupture results are averages from ten specimens, using a 5-inch span on a standard Olson test machine.

IV. Results

The physical properties of the series of batches are presented in Table II.

TABLE II

Batch No.	H_2O absorption (%)	Apparent sp. gr.	Fired shrinkage (%)	Modulus of rupture (lb./sq. in.) Dry	Fired
B-1	0.121	2.368	9.28	133	10904
B-2	0.057	2.392	9.79	136	12888
B-3	0.233	2.361	9.27	106	10030
B-4	0.133	2.381	9.15	106	12685
B-5	0.207	2.356	9.62	180	12206
B-6	0.202	2.349	9.80	107	10500
B-7	0.492	2.345	9.64	102	9985
B-8	0.316	2.348	8.64	142	11650
B-9	0.294	2.343	8.53	159	8600
B-10	0.277	2.337	9.22	201	12572
B-11	2.380	2.273	8.32	141	10625
B-12	0.072	2.370	9.66	99	13550
B-13	0.126	2.361	8.98	113	11621
B-14	0.498	2.340	9.29	131	10519
B-15	0.490	2.324	9.53	150	9171

The results are graphically analyzed in Figs. 1 to 6, inclusive.

V. Discussion of Results

The increase of the dry-mixing time of all ingredients from 2 to 10 minutes, with all other factors constant as for batches B-3 and B-4, respectively (Fig. 1), decreases the percentage of water absorption and the linear fired shrinkage and increases the apparent specific gravity and the fired modulus of rupture. A reversal in the trends of these properties results when a dry-mixing time of 30 minutes is used for batch B-5. The dry modulus of rupture is the same for the 2- and 10-minute batches, but it shows an increase after 30 minutes of dry mixing.

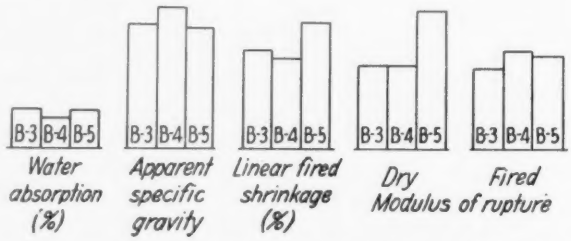

FIG. 1.—Varying dry-mix time of all ingredients for 2, 10, and 30 minutes, respectively, with all other factors constant.

The 5-, 10- and 30-minute wet-mix batches, with all other factors constant as in B-6, B-3, and B-7, respectively (Fig. 2), and with increased wet-mixing time, indicate an increase in percentage of water absorption and decreases in dry and fired modulus of rupture. An increase in apparent specific gravity and a decrease in linear firing shrinkage are found up to 10 minutes, followed by a decrease in this tendency for the 30-minute wet-mix batch.

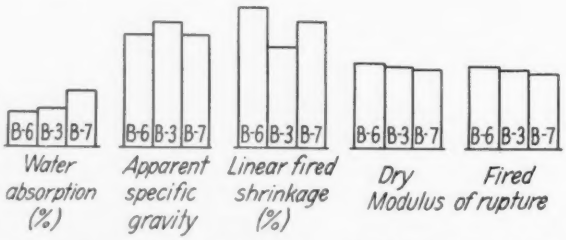

FIG. 2.—Varying wet-mix time of all ingredients for 5, 10, and 30 minutes, respectively, with all other factors constant.

Four sequences of compounding are presented in Fig. 3 for batches B-1, B-2, B-3, and B-14, respectively. From this comparison, it is apparent that the physical properties are best when the B-2 sequence is used in which the clays are dry-mixed for 2 minutes, followed by the addition of water and mixing for 5 minutes and by the slow introduction of the nonplastics during the first 5 minutes of a 10-minute wet-mix period. The least desirable method seems to be mixing all ingredients at one time as in batches B-3 and B-14. The dry modulus of rupture is not affected appreciably by any sequence of additions.

Figure 4 presents a comparison of the physical properties of batch B-2 with B-10, which was similarly mixed but had a sodium silicate addition; this addition resulted in an increase in percentage of water absorption and dry modulus of rupture and a decrease in apparent specific gravity, linear fired shrinkage, and fired modulus of rupture. The same results were obtained for B-8, B-9, and B-15 as compared to B-3, B-1, and

B-13, respectively, except for the increase in fired modulus in B-8 and an increase in shrinkage in B-15.

Figure 5 indicates that the introduction of deflocculated ball-clay slip to the other ingredients after dry-mixing, as in B-11, results in an increase in percentage of water absorption and a decrease in apparent specific gravity and linear fired shrinkage.

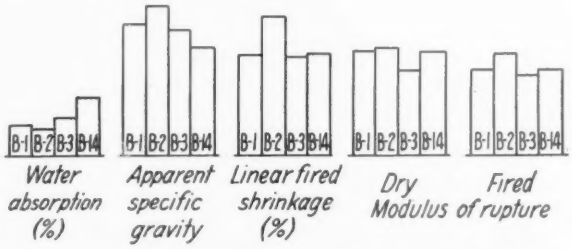

FIG. 3.—Varying sequence of compounding the mixture: B-1, nonplastics dry-mixed 2 minutes, followed by addition of water, mixing 5 minutes, and clays added slowly during first 5 minutes of 10-minute wet-mix period; B-2 reverses sequence and duplicates time for B-1; B-3, all ingredients dry-mixed for 2 minutes, followed by addition of water over first 5 minutes of 10 minutes' wet-mixing; B-14, all ingredients and water placed in mixer and mixed 10 minutes.

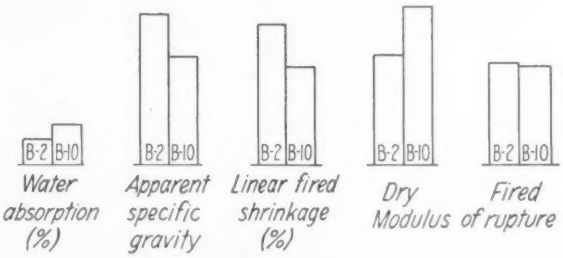

FIG. 4.—Effect of sodium silicate addition: B-2, no addition to tempering water; B-10, duplicates time and sequence of B-2 with sodium silicate added to tempering water.

In comparing B-12 (Fig. 6), containing acetic acid in the tempering water, with B-7, a decrease in percentage of water absorption and an increase in apparent specific gravity and in fired modulus of rupture are noted. The linear fired shrinkage and dry modulus of rupture were unaffected.

VI. Summary

These conclusions probably are applicable only to the particular body used. With the introduction of other factors, such as muller weight, pan and plow sizes, r.p.m. of machine, and different raw materials, the influence of the factors considered in this paper may be different.

(1) An increase from 2 to 10 minutes in dry-mix time for all ingredients results in improved physical properties.

(2) Increasing the wet-mix period more than 5 minutes has no advantage.

(3) The sequence of dry-mixing the clay fraction, followed by the addition of water to form a well-mixed slip before the introduction of the nonplastics, results in an improvement of all physical properties.

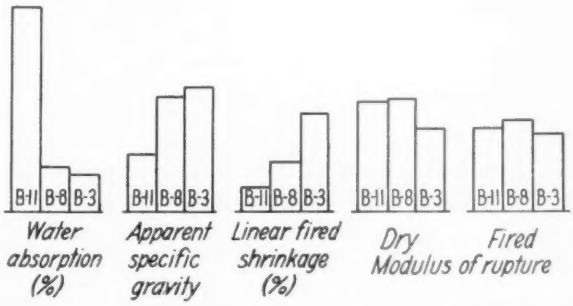

FIG. 5.—Effect of adding ball clays as a deflocculated slip: B-11, ball clays added as deflocculated slip; B-8, sodium silicate in tempering water, duplicates time and sequence of B-11; B-3, no additions to tempering water, duplicates time and sequence of B-11 and B-8.

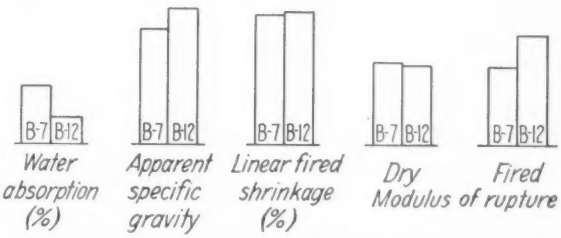

FIG. 6.—Effect of acetic acid addition: B-7, no additions to tempering water; B-12, acetic acid in tempering water.

(4) The introduction of sufficient sodium silicate in the tempering water to cause maximum deflocculation of the body causes detrimental effects on the physical characteristics except for the dry modulus of rupture. This same conclusion applies when ball clays are added as a slip deflocculated with sodium silicate.

(5) The introduction of acetic acid to the tempering water lowers the percentage of water absorption and increases the apparent specific gravity and fired strength.

(6) The observed influence of sodium silicate and acetic acid on the physical properties suggests the possibility of introducing controlled amounts of various soluble salts or liquid reagents to obtain the desired physical properties by this method of mixing.

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GENERAL MOTORS CORPORATION
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FURTHER DEVELOPMENTS IN DRY MIXING OF CERAMIC BODIES*

By F. A. Fix

Abstract

This progress report covers the actual results obtained by users of dry-mixing equipment. Applications of this method are increasing, and studies are being made in factories, laboratories, and research institutes. New uses for dry-mixed bodies are being developed, and in several instances, an improved body structure has been obtained.

I. Introduction

The mixing machine as a whole is standard, but those elements which actually perform the mixing operation must necessarily be adjusted to suit the type of body being prepared. The methods used in a number of plants are described.

II. Industrial Plant Results

In preparing a plastic mix, a plant that has changed from pressure-type mixers to mixing equipment more suitable for this material has found that (1) the mixing time has been reduced from several hours to 20 minutes, (2) a 50% savings in power has been obtained, and (3) labor costs have been reduced.

(*A*) *Electrical Refractories:* In an electrical refractories plant, the production cost of wet processing exceeded dry mixing by 143%, including the time required to clean the dry mixer when a change from one colored batch to another was necessary. The wet-processing operations previously used included weighing, blunging, filter-pressing, drying the filter cake, pulverizing, and tempering. In dry mixing, the increased cost of air-floated and bagged materials has amounted to not more than 70 cents per 1000 pounds, and the power reduction obtained is about 80%. The scrap at this plant is reworked by mixing batches of 100% scrap; the moisture content is determined, and the correct amount of water is added to bring it to the proper consistency. No difficulty has been reported from dirty scrap, and all commercial requirements as to strength, size, shape, and absorption have been met with the dry-mixing process.

(*B*) *Special Electrical Refractories:* In a plant making special electrical refractories, the clays were mixed with 50% water to facilitate blending, and they were dried to 5% of moisture, which is "press-dust" consistency. By the use of dry-mixing equipment, the driers have been eliminated, less floor space is used, and the quantity of water has been reduced, which has lowered the production costs. The present practice is to pulverize the clays, blend them in the clay mixer, and then to add the amount of water required for dry pressing. This process has reduced the mixing time cycle 75% and has improved the structure of the product.

(*C*) *Electrical Refractories and Specialties:* Another manufacturer of electrical refractories and specialties, including textile porcelains, has submitted the following data: "Our cost per ton of preparing a body by the wet-process method was $5.00 per ton. A savings of 20% has been effected by the dry-mixing method. The most important reason for using the dry-mixing method, however, lies in the flexibility in changing the body readily to fit the type of piece that is being manufactured."

This company formerly showed a loss of 25 to 33% between press room and cleaning room on pieces of intricate design made from wet-processed clay. These losses have been reduced to between 2 and 3%. This effects a much larger savings than those in body preparation, and the improvement is directly traceable to the fact that a 20% stronger body is made from material prepared in the dry mixer. Several of the most difficult pieces previously made from plastic body are now pressed from dry-mixed materials.

(*D*) *Electrical Porcelain:* A producer of electrical porcelain and ceramic specialties is using a large unit dry-mixing equipment for regular production; a smaller unit is used for small batches of special refractories. Piecework rates are now being adjusted and a savings of from 50 to 60% on direct labor cost is expected; similar savings are expected in indirect costs, such as maintenance, repairs, power, and depreciation.

The exact figures obtained from another ceramic plant in which the costs vary, depending on production, show that prepared bodies cost 30% less than the wet-processed materials. The body formula in this plant is always the same, but by means of adjustment on the dust mill or blower, the granule size is adjusted to suit the size and design of each special piece being pressed.

(*E*) *Wall Tile:* The use of dry-mixing equipment in wall-tile production has resulted in finished tile more uniform in size, which has simplified the sizing operation. The correct muller pressure is important to develop uniform dispersion and to correct a flaking condition of some of the dry plastic clay particles before the water is added. A practical method is to add scrap to the raw materials of each batch of tile body rather than to make up batches entirely of scrap. At one tile plant, this method has provided a closer check on the moisture content.

III. Air-Floated Clay and Lump Clay Costs

Air-floated clays were found to cost $8.50 per ton more than the same clay in lump form. The lump clay, however, contains water which represents $3.95 of the gross price per ton, and freight on this water represents $1.05 per ton. The loss of material in the wet processing of this clay furthermore amounts to 99 cents

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* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (White Wares Division). Received April 18, 1939.

For an earlier paper on this subject see F. A. Fix, "Dry-Mix Process in Plastic Body Preparation," *Bull. Amer. Ceram. Soc.*, **18** [9] 320–21 (1939).

per ton. Instead of 2000 pounds of clay per ton, only 1500 pounds of usable material from each ton of crude clay are obtained. This difference amounts to $5.99 per ton, and the price of lump clay is thus increased to close to $26.00 per usable ton. The difference between the cost of air-floated and lump clays therefore is not nearly as great as it appears.

NOTE: The best results have been obtained at the latter plant with materials sized to 250-mesh or finer. Presized and finely prepared ceramic materials should be placed in dry storage, preferably in paper sacks and on slatted platforms to allow complete circulation around, under, and over the stored materials, which prevents the materials from becoming damp and small hard nodules to develop.

LANCASTER IRON WORKS, INCORPORATED
LANCASTER, PENNSYLVANIA

PROMOTION OF INTERFACIAL REACTIONS TO COUNTERACT CRAZING*

BY ROBERT M. CAMPBELL

ABSTRACT

Thin mineral layers were applied to biscuit vitreous and semivitreous whiteware bodies. These layers subsequently were coated with a glaze and were fired at a glost temperature. A better glaze texture was obtained in certain cases, as well as increased crazing resistance.

I. Introduction

When a glaze begins to fuse, the interaction of the body and the glaze establishes an intermediate composition zone between the body and the glaze.

According to Mellor,[1] the general effect of the reaction between the body and glaze is to bring the two in closer harmony. If the intermediate "cushion" is not adequately developed, crazing may ensue.

A comparison of thin sections of the body, glaze, and interface of one-fired ware with ware made by the two-fire process showed greater erosion of the body by the glaze and a more advanced growth of interfacial crystals in the ware fired once.

II. Historical Survey

Schramm[2] states that initial fusion occurs at the glaze body contact with progressive development to the outer surface of the glaze and that the earliest reaction appears to be a combination of frit and raw lime. He applied thin washes to unfired green ware of flint, calcined clay, raw clay, feldspar, and alumina, and the samples were biscuited, glazed, and glost-fired together with normal untreated ware. The most perfect result was obtained over the alumina wash; the silica wash produced an immature glaze. The remainder of the washes gave intermediate results.

Because the glaze does not fuse as a homogeneous matrix and because an advanced state of fusion is desired at the interface, it seems logical to apply thin washes to the biscuited ware that would produce early fusion and promote greater interfacial reaction. Sephton and others[3] state that such layers in certain cases produce a better glaze texture with some indication of better crazing resistance. The washes that fused gave the best appearance, and the most satisfactory results were obtained with washes that showed fusion or partial fusion.

III. Procedure

Thin washes, approximately 0.002 inch thick, were applied to biscuited vitreous electrical insulator body tile. The tile were in the form of 2-inch disks. The same washes were used in the same manner on 2- by 2-inch commercial semivitreous wall tile. Fritted lead glazes were applied to the samples over the washes, and the glazed pieces were fired to cone 5.

The washes were as follows: (1) borax; (2) No. 5 Minpro feldspar; (3) No. 45 glaze feldspar; (4) nepheline syenite; (5) No. 3 frit; (6) No. 100 frit; (7) Oxford feldspar 80%, talc 20%; (8) No. 45 glaze feldspar 80%, talc 20%; (9) Oxford feldspar 60%, spodumene 40%; (10) No. 45 glaze feldspar 60%, spodumene 40%; (11) No. 45 glaze feldspar 50%; nepheline syenite 50%; (12) No. 3 frit 50%, borax 50%; (13) No. 3 frit 50%, talc 50%; (14) No. 3 frit 25%, talc 75%; (15) Oxford feldspar 50%, talc 50%; and (16) No. 45 glaze feldspar 50%, talc 50%.

Table I gives the chemical compositions of the raw materials used as washes.

The following glazes were used:

Cone 5 vitreous glaze

$$\left.\begin{matrix}0.054\ KNaO\\0.500\ CaO\\0.446\ PbO\end{matrix}\right\}\ 0.27\ Al_2O_3\ \left\{\begin{matrix}2.70\ SiO_2\\0.32\ B_2O_3\end{matrix}\right.$$

Cone 5 semivitreous glaze

$$\left.\begin{matrix}0.240\ KNaO\\0.400\ CaO\\0.360\ PbO\end{matrix}\right\}\ 0.30\ Al_2O_3\ \left\{\begin{matrix}3.00\ SiO_2\\0.40\ B_2O_3\end{matrix}\right.$$

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 17, 1939 (Symposium on Glaze Properties). Received April 17, 1939.

[1] J. W. Mellor, "Crazing and Peeling of Glazes," *Trans. Ceram. Soc.* [England], **34** [1] 1–112 (1935); *Ceram. Abs.*, **14** [9] 233 (1935).

[2] Edward Schramm, "Problems in Whiteware Glazes," *Bull. Amer. Ceram. Soc.*, **17** [11] 436–40 (1938).

[3] H. Sephton and others, private communication.

TABLE I

CHEMICAL COMPOSITIONS OF RAW MATERIALS IN WASHES

Column No.: (1) Oxford feldspar, (2) Minpro No. 5 feldspar, (3) No. 45 glaze feldspar, (4) nepheline syenite, (5) spodumene, (6) tremolite talc, (7) No. 3 frit, (8) No. 100 frit, (9) borax.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SiO_2	65.6	69.3	68.7	60.2	68.9	55.9	49.3	31.0	
Al_2O_3	19.3	18.4	19.5	24.1	24.1	0.7	8.4	4.1	
Fe_2O_3	0.07	0.06	0.09	0.06	0.74				
CaO	0.3	0.8	0.6	0.2	0.3	6.2	9.2	9.2	
MgO	T	T	T	T		30.7			
K_2O	11.5	5.5	1.4	4.5		T			
Na_2O	2.8	5.6	9.5	10.5	1.3	0.5	10.2	2.5	16.2
Li_2O					4.9				
B_2O_3							22.9	16.5	36.6
PbO								36.7	
Ignition loss	0.2	0.3	0.2	0.5	0.1	6.0			47.2

The fired samples were examined for surface texture and for crazing resistance. The resistance to crazing was tested by quenching the specimens from 140°C. to running cold water at 10°C. and by counting the number of cycles required to produce failure.

The results of the crazing-resistance tests are given in Table II.

TABLE II

Resistance	Vitreous body, cone 11, and glaze, cone 5 (glaze No.)	Semivitreous body and glaze, cone 5 (glaze No.)
Better	1, 3, 5, 6, 8, 9, 11, 12	1, 2, 5, 6, 12, 14
Equal	2, 7, 13	3, 15, 16, 12
Less	4, 10, 14	4, 10

IV. Results

All specimens as observed after removal from the kiln had an acceptable texture with no indication of crazing. The nepheline syenite wash produced a slight eggshell surface. The glazes alone and over the washes showed good crazing resistance. Most of the specimens did not craze after twenty-five cycles of quenching from 140°C. to running cold water. It was necessary to quench from higher temperatures to induce crazing.

Linear coefficients of expansion, according to Hall,[4] were made on the body and the washes, but no correlation could be made.

V. Conclusions

Light applications of intermediate washes that fused at the glost temperature had no decided effect on the glaze texture. Those washes which were markedly fusible, viz., borax, No. 3 frit, and No. 100 frit, gave a glaze texture slightly superior to "glaze only."

In no case was the effect of the underglaze wash either decidedly advantageous or disadvantageous on crazing resistance. Slight tendencies, however, were noted in the improvement of glaze fit, particularly when a thin layer of frit was used.

[4] F. P. Hall, "Influence of Chemical Composition on Physical Properties of Glazes," *Jour. Amer. Ceram. Soc.*, **13** [3] 182–99 (1930).

NEW YORK STATE COLLEGE OF CERAMICS
ALFRED, NEW YORK

PROGRESS REPORTS FROM THE ELECTROTECHNICAL LABORATORY, BUREAU OF MINES, AT NORRIS, TENNESSEE*

BY HEWITT WILSON, M. S. NELSON, AND STAFF

ABSTRACT

These three progress reports from the Electrotechnical Laboratory, Bureau of Mines, Norris, Tenn., include (I) studies on the warpage of plates; (II) uniform electric firing of bisque chinaware; and (III) electric heating elements for ceramic firing to 1400°C., (1) life test on graphite heating elements, (2) operating conditions, and (3) self-cooled silicon-carbide resistors in a continuous tunnel kiln. Each of these studies is being continued at the Laboratory.

I. Warpage of Plates

Warpage is caused by nonuniform shrinkage during drying and firing, handling in the damp deformable condition, and irregular softening and support at the end of the vitrification period. The many causes of irregularity include (1) varying porosity and trueness of the plaster molds, (2) poor structural design of the plate cross section, (3) unequal water distribution and particle orientation of the clay mixtures, (4) poor technique of the molding operation, (5) irregular drying, (6) irregular application of heat, and (7) imperfect support for the plates in stacks or bungs in the kiln. The plate whose shape approaches that of a disk with poor vertical bracing and a cantilever-supported rim is one of the most difficult shapes to keep straight.

The Tennessee Valley Authority ceramic laboratory staff cast thin, straight-rimmed, translucent plates with an overcast foot and supported them during heating on prefired rings. The work with thick, inclined-rim plates of the hotel type had just started when the Bureau of Mines took charge of the laboratory.

* Received September 26, 1939.
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Warpage of commercial products was recorded with a new machine designed and built in the laboratory. Tests of bisque, hotel-plate bungs (supplied by the manufacturers as well as those of finished ware from the Norris and Knoxville restaurants) showed an average waviness of the rim (rim warpage) of 0.065 inch for 7-inch rolled-edge plates and an average height warpage of 0.075 inch.

Sixty bungs of eight plates each have been made, fired, and measured, but the problem is not complete; 60% of the warpage occurs in drying. The rim angle of the plate as molded decreases from 23° to 20° with a lowering of the rim height as the plate, in its inverted position on the mold, shrinks up the slope or over the "ball" toward the center. Equal and uniform shrinkage is not produced in all parts of the clay mass for the rim edge lifts first in an irregular fashion from the plaster. If the damp piece is lifted from the mold with the hands on opposite sides of the rim, two corresponding valleys and crests will be noted after firing.

If the bung of plates is fired to the semivitrified rather than to the softened condition, irregular firing causes new changes in shape and the continuation of strains started during drying. The weight of a tall bung of thin plates prevents normal shrinkage of the bottom supporting members; or, if spacing materials are used with the thicker hotel plates and most of the load is applied to the rims instead of the feet, the lower plate may lift the whole bung in the center, producing a shallow plate at the bottom and a well-dished plate at the top

As the temperature is raised, the clay mass attains a softened condition requiring a support, first, for the overhanging rim, and then for the center when long central spans are used. The common commercial method of support consists of mechanically vibrating quartz sand between the rims of the assembled bung, and in most instances this produces a flat plate of larger diameter at the bottom and a higher and deeper plate at the top of the bung. The use of machined and prefired refractory rings with and without an outside support gave better results than the use of loose sand in these tests. This study is being continued.

II. Bisque Firing of China by Electricity

(1) Uniformity of Electric Firing

Tests on the uniformity of ceramic firing were made in periodic electric kilns of 7 cubic feet capacity and a twin-tunnel electric kiln 55 feet long. In these kilns, where radiation and natural convection alone were the source of heat transmission to the ware, the temperature distribution varied with the rate of heating, the time of "soaking" at the highest temperature, the arrangement of the heating elements, their independent control, the density of the setting, and the distance of the product from the hot elements and from the cold doorways. The distribution under the best conditions was comparable to that found in combustion-fired kilns, but the temperature was more easily controlled in the electric kiln.

Uniformity was determined by temperature indicators, by concealed and open standard pyrometric cones, and by the usual ceramic vitrification tests including shrinkage and warpage. That commercial unifo mity was achieved was demonstrated by the successful firing of full-size complicated sanitary ware, 26 by 17 by 16 inches in size, when the top of the piece was within two inches of the silicon-carbide resistors. This study is being continued.

III. Electric Heating Elements for Ceramic Firing to 1400°C.

(1) Life Tests on Graphite Heating Elements

Graphite resistors[1] were set up in a small furnace to operate at 1400°C. under the best-known conditions as determined by previous work of the TVA ceramic laboratory staff. An average life of 1800 hours, with six of the original fourteen resistors still in service, had been obtained in the continuous tunnel kiln. The first of the life-test resistors failed after 3120 hours, the second after 3408 hours, and the third after 4872 hours, giving an average of 3800 hours for the three. Permeability tests indicated that the assemblies ailed in order of permeability, the most porous failing first, etc. The chief factors contributing to the longer life in this test appeared to be (1) fairly gas-tight tubes, (2) precautions and tests to insure gas-tightness of the end assembly, and (3) the larger cross-section area of the graphite terminals, allowing more oxidation to take place before failure occurred.

(2) Special Tests and Investigations

Several studies of the operating conditions of the graphite resistor were made, including (1) a review of the pyrolysis of the hydrocarbon gases (used to maintain a protective atmosphere inside the resistor assemblies), (2) determination of the temperature gradient of the graphite terminal and its relation to hydrocarbon pyrolysis, (3) use of several protecting gases, such as nitrogen, propane, hydrogen, and acetylene, with complete analyses being made of the products of reaction inside the protecting tube, (4) moisture determinations of gases before and after introduction, (5) protection of the graphite terminals with metal sleeves, using nickel, iron, Nichrome, aluminum, and electroplated nickel, and (6) glazing the outside of protection tubes to lower porosity.

An improvement was made on the conventional end terminal seal, and an improved type was developed and tested. Slip-joint connections in the graphite were tested with satisfactory results, indicating a simpler method of manufacture and the possibility of salvaging old assemblies.

One of the most important discoveries made was that oxygen diffuses through the silicon-carbide protection tubes, even against positive internal pressure of other gases, and that tightness of the tube and end seal apparently are more important for long life than the type or amount of protecting gas used.

[1] Tennessee Valley Authority Ceramic Laboratory Staff, "Final Progress Report," *Jour. Amer. Ceram. Soc.*, **22** [7] 205–45 (1939); p. 226.

Experiments indicate that 950° to 1000°C. is the minimum safe operating temperature of the graphite resistor in the present silicon-carbide protection tube assembly.

(3) Self-Cooled Silicon-Carbide Resistors in a Continuous Tunnel Kiln

Provisions were made for operating the continuous kiln using silicon-carbide resistors (the only commercial nonmetallic heating element on the market at present) equipped with self-cooled terminals to give a comparison with behavior and operating characteristics of the graphite resistor.

A check at cone 13 down on a 60-hour schedule showed 11.2% less power input with the silicon-carbide than with the graphite resistors, a condition that probably was due to the smaller cross section of the graphite terminals, which allowed a relatively low heat transfer and radiation loss through the terminals.

At 1176 hours, the silicon-carbide resistors showed an average resistance increase of 46.9%. This study is being continued.

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Bureau of Mines
Norris, Tennessee

SUMMARY OF OCCURRENCE, PROPERTIES, AND USES OF VERMICULITE AT LIBBY, MONTANA*

By W. Wurth Kriegel

Abstract

Vermiculite is the name of a group of micaceous, hydrated silicates which are the alteration products of micas. The Libby mineral resembles jefferisite. Chemical analyses are given, and the history of the deposits is briefly reviewed. The mineral, which occurs in a stock intruding the Algonkian Belt series of the valley, is used principally in thermal insulation and also for acoustical and dehydration purposes. The coefficient of thermal conductivity varies between 0.26 and 0.35, the P.C.E. value is 11, and the coefficient of sound absorption varies from 0.34 to 0.58.

I. Introduction

Vermiculite is neither a rare nor a newly discovered mineral group, but until recent years it has remained a mineralogical curiosity without any particular value or use. With increasing public and industrial interest in thermal insulation in the last few years, vermiculite has become an important insulating material.

II. Mineralogy

Vermiculite is the group name of a number of micaceous minerals, all of them hydrated silicates. The chemical composition is indefinite, varying with the composition of the original mineral and the degree of alteration. When the dried material is heated to redness, it exhibits the characteristic property of all vermiculites, i. e., great expansion.

Dana[1] lists fourteen varieties from various sources. The Libby vermiculite appears to resemble most closely the physical properties of jefferisite which Dana describes as follows: "In broad crystals or crystalline plates. Surface of plates often triangularly marked by crossing lines 60 and 120 degrees. Cleavage: basal, eminent. Flexible, almost brittle. H=1.5. G=2.30. Luster pearly on cleavage surface. Color dark yellowish-brown and brownish-yellow; light yellow by transmitted light; also greenish-yellow."

Chemical analyses of the Libby vermiculite are shown in Table I.

Table I

Chemical Analyses

Column (1) analysis by J. C. Meyer, chief chemist, Great Northern Railway Co.; (2) analysis by National Bureau of Standards; and (3) analysis by Universal Insulation Co.

	(1)	(2)	(3)
Silica	42.8	41.0	42.6
Alumina		18.0	19.0
Iron oxide	26.2	7.0	7.2
Calcium oxide	1.9	1.0	1.9
Magnesium oxide	24.6	21.0	24.6
Sodium and potassium oxides	3.6	1.0	3.8
Moisture	0.7	11.0	
Total	99.8	100.0	99.1

III. History

Though many deposits of vermiculite have been found throughout the United States, including North Carolina, South Carolina, Colorado, New Mexico, California, Idaho, Wyoming, the New England States, and other parts of Montana, the history and development of the industry are closely allied with that of the Libby deposits and companies. The Libby deposits are reputed to have been discovered by the late E. N. Alley while he was prospecting for vanadium minerals during the World War. It is said that the heat of his candle caused the coarse, micalike mineral to swell and assume a golden color. He called the material "feather gold."

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[1] E. S. Dana, System of Mineralogy, Descriptive Mineralogy, 6th ed., pp. 664–68. John Wiley & Sons, Inc., New York, N. Y., 1892.

Mr. Alley and a group of associates formed the Zonolite Company to exploit these deposits. In 1925, the Company began to market the expanded material in a small way. The mine and plant were operated at Libby and a plant and research laboratory at Detroit, Mich. Through licenses and contracts, the unheated material was supplied to expanding plants throughout the United States. In 1934, the Universal Insulation Company acquired the holdings of the Vermiculite and Asbestos Company of Libby, Mont., and operated properties adjacent to those of the Zonolite Company. The Universal Insulation Company had a similar distribution system with offices and laboratory at Chicago, Ill. In May, 1939, the two companies were combined in a new company called the Universal-Zonolite Insulation Company. The products, under the trade names of "Zonolite," "Unifil," and "Porosil," are being manufactured in nineteen American and Canadian cities; the mineral is being exported to England, Brazil, and Australia; and there are projected plants in South Africa and France. The expanded products are being sold in many other countries.

(1) Topography

The deposits are approximately seven miles northeast of Libby in the lower part of the Rainy Creek Valley, two miles above its mouth. A service road leads from the main highway along the Kootenai River. The valley widens near the deposits owing to the junction of several small branch valleys. Mountains rise 1000 feet or more above the drainage level.

(2) General Geology

According to Pardee and Larsen,[2] the Rainy Creek Valley "is underlain chiefly by argillite and quartzite that apparently are the equivalents of the rocks exposed along the Kootenai River west of Libby." These rocks are described in detail by Calkins.[3] Pardee and Larson say further that the rocks in the Rainy Creek Valley in general exhibit moderately steep dips and open folds that trend northwestward and that they "doubtless belong to the Algonkian Belt series."

A stock composed of about two-thirds pyroxenite and one-third syenite and their alteration products intrudes the Belt series and underlies about six square miles of this area. Pardee and Larsen say that subsequent alteration has taken place over wide areas.

(3) Occurrence and Development

Generally, vermiculite is an alteration product in altered igneous rocks and is distributed throughout the rock. It occurs in certain places in large bodies as in the Rainy Creek district.

The deposits extend in a generally east-west direction. The east end (worked by the former Zonolite Company) contains a high concentration of vermiculite. Large bodies run as high as 95% vermiculite. In these areas of high concentration, however, cores of partially altered biotite which expand poorly are encountered. This portion of the deposit has been developed by numerous pits, ranging from 25 to 40 feet deep and 100 to 250 feet long (Fig. 1). The property has been developed further by a 400-foot adit, which is 400 feet under the surface at the face and is reputed to be in good-quality material.

The west end of the deposits (operated by the former Universal Insulation Company) shows few accumulations of biotite. A series of syenite dikes, ten to fifty feet apart and roughly conformable in strike with the ore zone, block off the ore. The concentration of vermiculite varies from 30 to 60% with pockets of higher concentration. These dikes are thought to have been the source of solutions that altered the pyroxenite in whole or in part into vermiculite in this end of the zone.[4] A second series of dikes intersecting the ore body consists of material high in amphibole asbestos with less altered pyroxenite. Where the concentration of asbestos is sufficiently high, it is mined and marketed. The vermiculite is a minor constituent of this zone.

FIG. 1.—Portion of a pit in the Zonolite workings showing syenite dikes, *S*, cutting through the vermiculite, *V*.

IV. Mining and Concentrating

The Zonolite Company mined the ore by hand shoveling, selecting only the very high-grade rock; the Universal Company mined the deposits by power shovel on 30-foot benches between the syenite dikes. The dikes were toppled over periodically and trucked to a waste dump. The consolidation of the two companies, which has placed the entire deposit consisting of a mountain approximately 1000 feet high and a square mile in area under a single management, makes possible a more efficient plan of mining. At present, a $1^1/_4$-yard, Northwest gasoline shovel is leveling off the top of the

[2] J. T. Pardee and E. S. Larsen, "Deposits of Vermiculite and Other Minerals in Rainy Creek District, near Libby, Mont.," *U. S. Geol. Surv. Bull.*, No. 805-B, pp. 17–29 (1928); see pp. 18–24.

[3] F. C. Calkins, "Geological Reconnaissance in Northern Idaho and Northwestern Montana," *ibid.*, No. 384, 112 pp. (1909); p. 76.

[4] P. M. Tyler, "Minor Nonmetals: Graphite, Greensand, Kyanite, Mineral Wool, Monazite, Strontium Minerals, Vermiculite, and Wollastonite," U. S. Bur. Mines Minerals Yearbook, p. 1072 (1936).

mountain, preparatory to cutting the mountain down in 25-foot horizontal cuts; the ore is trucked down the mountain to the mill on the west slope; waste rock is discarded on barren ground. During the summer and fall months, approximately 250 tons of ore are being mined in an 8-hour day which supplies the mill for 24 hours.

The concentrator used was built by the former Universal Insulation Company. The ore from the mine is dumped on a grizzly, 28 by 3 feet in size with 4-inch openings. The oversize rolls out to the waste pile and the − 4-inch material falls into a 1000-ton steel bin. An apron feeder feeds to a 24-inch inclined belt conveyer, which carries the material to the top of the mill building, discharging into a trommel, 4 by 8 feet with $^3/_4$-inch openings. The oversize goes to waste and the undersize to a jigger screen with $^1/_2$-inch openings; the oversize of the screen passes through one of two hammer mills. The two products pass through a baffled, conical-shaped, oil-fired, flash drier, operating at 300°F., which removes the surface moisture of the vermiculite. The dried material is much easier to screen. From the drier, the material passes through a battery of two Hummer screens. The products are raised by two bucket elevators and are passed through a battery of four Hummer screens which size the material for the separators.

Thirty-two specially built air-separators, making a concentrates, a middlings, and a tailings product, remove the greater bulk of the waste rock. The middlings product, which consists mainly of small, thick books of vermiculite, is returned to the hammer mills for further grinding. The concentrates product passes directly into a 5- by 16-foot, oil-fired, Link-Belt rotary drier. All excess moisture that is not needed for the subsequent expansion of the vermiculite is removed. The moisture content of the vermiculite is periodically checked in the laboratory. The material passes from the drier through a triple-deck, jigger screen, which delivers the vermiculite into the four commercial sizes, designated as 1A, 1, 2, and 3, which are $-^1/_2$-inch to +3-mesh, −3 to +14, −10 to +20, and −16 to +24-mesh, respectively. The 1, 2, and 3 sizes pass through separate air-separators and then to storage bins. All waste rock is transported to a waste dump by a belt conveyer.

Two counter-balanced, $1^1/_2$-ton cars lower the sized concentrates along a 2800-foot incline to receiving bins at the foot of the mountain, and they are trucked about 8 miles to Libby where they are shipped in box cars or placed in storage. The present storage capacity is 2500 tons, but additional bins are being constructed.

The concentrator operates most economically on ore containing from 50 to 60% of vermiculite, produces 125 to 160 tons of concentrates per 24-hour day, and makes an 80% recovery. The principal loss is in the fine sizes for which at present no adequate market has been developed. The electric power for the mill is generated by two direct-connected, Superior, 215-h.p. Diesel engines. One of these engines also drives a Seroco fan, which delivers 8000 cu. ft. of air per minute to the air separators. Repairs on the equipment are made on Sundays when the mill is closed. The estimated production of the company for 1939 is 20,000 tons of concentrates.

Constant checks on the quality of feed and product are made in a small field laboratory. The expansibility of the ore, the percentage of waste rock, and the total water content of the vermiculite are determined.

V. Exfoliation

When vermiculite is heated to redness, it expands to corklike pieces of material, increasing up to sixteen times the original volume. Tyler[5] states that "experience seems to indicate that no vermiculite product after exfoliation, weighing more than 6 lb. per cu. ft., can be marketed successfully, and although there are many deposits of material that will show a considerable expansion on heating, few yield material that expands sufficiently to meet this requirement. Many vermiculites, moreover, decrepitate when expanded and fail to yield a blocky, corklike product, such as the trade demands for many purposes."

The reason for the phenomenal expansion of vermiculites has been assigned to the sudden expulsion by the application of heat of the chemically combined water and the water held between the folia of the mineral. The total water left in the mineral must not be reduced to less than 5 or 6% to obtain maximum expansibility.

FIG. 2.—Expanding plant of the Unifil Division, Asbestos Supply Co., at Spokane, Wash.

A typical expanding unit is shown in Fig. 2. The vermiculite is loaded into the hopper, *A*, by wheelbarrow. An 8-inch, variable-speed, electric-vibrator feeder drops the vermiculite into the boot of elevator *B*, which discharges it by means of a 3-inch flight conveyer into the preheating chamber, *C*, of the expanding unit. The preheating chamber is a double-walled cylinder, and the inner cylinder contains conical baffles which impede the fall of the vermiculite. The products of combustion from the burners pass up through the falling vermiculite. The air for the gas burners is preheated as it passes through the annular space between

[5] P. M. Tyler, *loc. cit.*, pp. 1069–70.

the two walls of the preheating chamber. The six burners using preheated air and artificial gas discharge directly into primary expanding chamber, *D*, and maintain a temperature of approximately 2000°F. The expanded vermiculite is removed by a 6-inch flight conveyer and is delivered to the boot of elevator *E*, which discharges via a chute to two bagger bins, *H*. To remove any rock or unexpanded vermiculite, a small fan forces air upward through pipe *F* through a slot opening in the bottom of the chute to the bagger bins. Directly below the slot and closing off the lower half of the chute, there is a 12-mesh screen over which the expanded vermiculite is carried by the force of the air current. The rock, being heavier, falls against the airstream down pipe, *G*.

The unit is capable of expanding 500 bags, 4 cubic feet in size and weighing approximately $5^1/_4$ lb. per cu. ft. The tops of the two elevators and the expanding unit are connected to an exhaust fan which removes the dust. The dust loss is approximately 2% and the rock loss 7% in the operation.

VI. Uses and Properties

As usual with new products, many uses have been suggested and are being tried with varying degrees of success. The principal use has been as "loose-fill" insulation for dwellings and buildings, refrigerators, and furnaces. Size No. 1 is used for these purposes. Table II gives the thermal-conductivity values of the material.

TABLE II

THERMAL CONDUCTIVITY OF LOOSE-FILL EXPANDED VERMICULITE

Test No. 1 is "Unifil," tested by P. C. Peebles, mechanical engineer, Armour Institute of Technology, Chicago, Ill.; Nos. (2) and (3) represent "Unifil," tested by W. T. Miller, professor of heating and ventilating, Purdue University, Lafayette, Ind.

	(1)	(2)	(3)
Density (lb./cu. ft.)	6.2	5.59	5.59
Mean temperature of test (°F.)	24	70	90
Thermal conductivity (B.t.u./hr./°F./sq. ft./in.)	0.317	0.245	0.263

Size No. 2 is being used for aggregate in insulating plasters, in insulating concrete for basement floors and furnaces, and in the tropics for homes. This size is also being used with suitable binders, generally cement, high-alumina cements, etc., for heavy-duty insulating brick on furnaces. The fusion temperature of vermiculite is cone 11. With gypsum and similar binders, it is being formed into steam-pipe coverings.

The total output of the smaller size, No. 3, is being used with a wood-fiber base in the manufacture of fire-resistant, insulating wall-boards and acoustical tile.

The large size, No. 1A, finds its chief use in acoustical plasters, wall finishes, and as acoustical tile. Coefficients of sound absorption of a $3^3/_4$-inch loosely compacted layer of Zonolite, for various frequencies of sound waves, are shown in Table III.

TABLE III

SOUND ABSORPTION*

Frequency of test tone	Coefficient of sound absorption
128 dv	0.34
256	.45
512	.58
1024	.57
2048	.56
4096	.56

* Tests by V. O. Knudsen, November 21, 1928.

Some of the less important uses are sound insulation for motor cars, grease lubricant, fillers for tires and rubber goods, and fireproofing.

Depending upon the conditions during the expansion of the material, colors ranging from near silver to gold can be produced. Very fine sizes are being used for extenders in gold and bronze paints and inks and in wall-paper printing.

"Lamisilite" (laminated silica) is produced by leaching unheated vermiculite with hot concentrated sulfuric acid, which leaves nearly pure SiO_2 in flake form. It is used as a dehydrating agent in air-conditioning units and industrial applications. Lamisilite will absorb about 20% by weight of water and may be renewed by heating.

Acknowledgment

The writer wishes to express his appreciation for the courtesies and assistance of R. R. Mount, plant superintendent, Unifil Division, Asbestos Supply Co., Spokane, Wash., and J. B. Meyers, Superintendent of Operations, Universal-Zonolite Insulation Co., Libby, Mont.

MONTANA BUREAU OF MINES AND GEOLOGY
BUTTE, MONTANA

RESIDUAL ALASKITE KAOLIN DEPOSITS OF NORTH CAROLINA*

By Charles E. Hunter

Abstract

The major residual kaolin deposits of North Carolina were formed from large alaskite granite bodies rather than from small narrow pegmatite dikes as was previously thought. The detailed geologic map of these deposits in the Spruce Pine area clearly shows the large tonnage of reserve kaolin. Although these deposits have long been known and have produced considerable kaolin for ceramic and other uses, little work has been published concerning them. It is hoped that this report will familiarize American ceramists with this area, enabling them to understand its potentialities.

I. Introduction

American consumers of kaolin should become better acquainted with the available high-grade American kaolins because there is an ample supply of fine china clay in this country. The tonnage of these deposits is recognized to be much larger than was previously thought. There are approximately 51,000,000 tons of crude kaolin in Avery, Mitchell, and Yancey counties of North Carolina. These counties, known as the Spruce Pine district, contain practically all of the commercial residual deposits of kaolin derived from alaskite in North Carolina. Of special interest to the ceramist is the extremely low iron content and the occurrence of only a trace of titanium in the kaolin. This kaolin is of exceptionally fine grade and is now being produced for the china clay consumers by two modern kaolin refining plants[1] and several older plants located near Spruce Pine, North Carolina. The demand for this kaolin, however, is rapidly increasing for use as various fillers and in special products.

II. Geology

The kaolin deposits in the Spruce Pine area for many years were considered to be the result of kaolinization of long, narrow pegmatite dikes,[2] but this assumption now is known to be incorrect. These kaolin deposits have been found to be large and irregular in shape and to have been formed from huge bodies of coarsely crystalline, white granite (alaskite†) containing practically no iron-bearing minerals. This white feldspathic granite has been named the "Spruce Pine alaskite" by Hess.‡ All the feldspathic rocks in the vicinity of Spruce Pine, however, are not of the alaskite variety. A common type of pegmatite outcrops at many places in the area, and even the alaskite bodies are cut by many pegmatites.

III. Alaskite

To understand the residual kaolin deposits occurring in the Spruce Pine area, it is necessary to know something about the remarkable rock formation, termed the "Spruce Pine alaskite," which is the parent rock of the kaolin.

The Spruce Pine alaskite has its greatest development in the vicinity of Spruce Pine, Mitchell County, North Carolina, and outcrops at irregular intervals over an area of about 225 square miles. The largest of the unbroken alaskite bodies occurs two miles northwest of Micaville, Yancey County, North Carolina, and it has an outcrop width of about one mile and a length of two and one-half miles. Figure 1 shows the location of the alaskite and kaolin deposits.

The alaskite was originally intruded as a magma into mica schist and biotite-hornblende gneiss; these intrusions were later affected by much folding and faulting; and they now crop out in long irregular bodies with the longer axis parallel to the regional strike, which is about north 45 degrees east. Many of these bodies appear originally to have been intruded as huge sills. The present dip of such intrusions is about 30 degrees to the southeast. Some bodies, however, dip vertically and even to the northwest, but these dips occur only locally near huge faults or folds.

The alaskite is folded with the schist (see Fig. 1). Schist inclusions of various dimensions are numerous within the alaskite bodies, and the larger inclusions are orientated approximately parallel to the trend of the country rock (Fig. 2). The heat, pressure, and magmatic solutions associated with intrusions of the alaskite magma have greatly increased the mica content of the invaded schists and included horses (fragments of schist surrounded by alaskite). These schist inclusions are numerous in the alaskite bodies a short distance west of Spruce Pine, North Carolina.

The Spruce Pine alaskite is a nearly white granitic rock, consisting of microcline and plagioclase feldspar, quartz, and muscovite mica, with pegmatites, which here and there contain rare minerals such as thulite, hyalite, uraninite, columbite, samarskite, and beryl (Fig. 3). Albite, the soda feldspar, is the most predominant of the plagioclase feldspars present. The alaskite in pegmatitic parts is extremely coarse textured

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (Materials and Equipment Division). Received April 11, 1939.

[1] (*a*) J. R. Grout, Jr, "Better China Clay," *Eng. Mining Journal*, p. 341 (July, 1937).

(*b*) J. R. Grout, Jr., "New Process North Carolina Kaolin Refinery," *Bull. Amer. Ceram. Soc.*, **16** [10] 387–90 (1937).

[2] (*a*) A. S. Watts, "Mining and Treatment of Feldspar and Kaolin in Southern Appalachian Region," *U. S. Bur. Mines Bull.*, No. 53, 170 pp. (1913); p. 12.

(*b*) H. Ries, "Clay Deposits and Clay Industry in North Carolina," *N. C. Geol. Surv. Bull.*, No. 13, 157 pp. (1897).

† Igneous rock consisting essentially of quartz and alkalic feldspar without black minerals.

‡ Frank L. Hess, Principal Mineralogist, U. S. Bureau of Mines, personal communication.

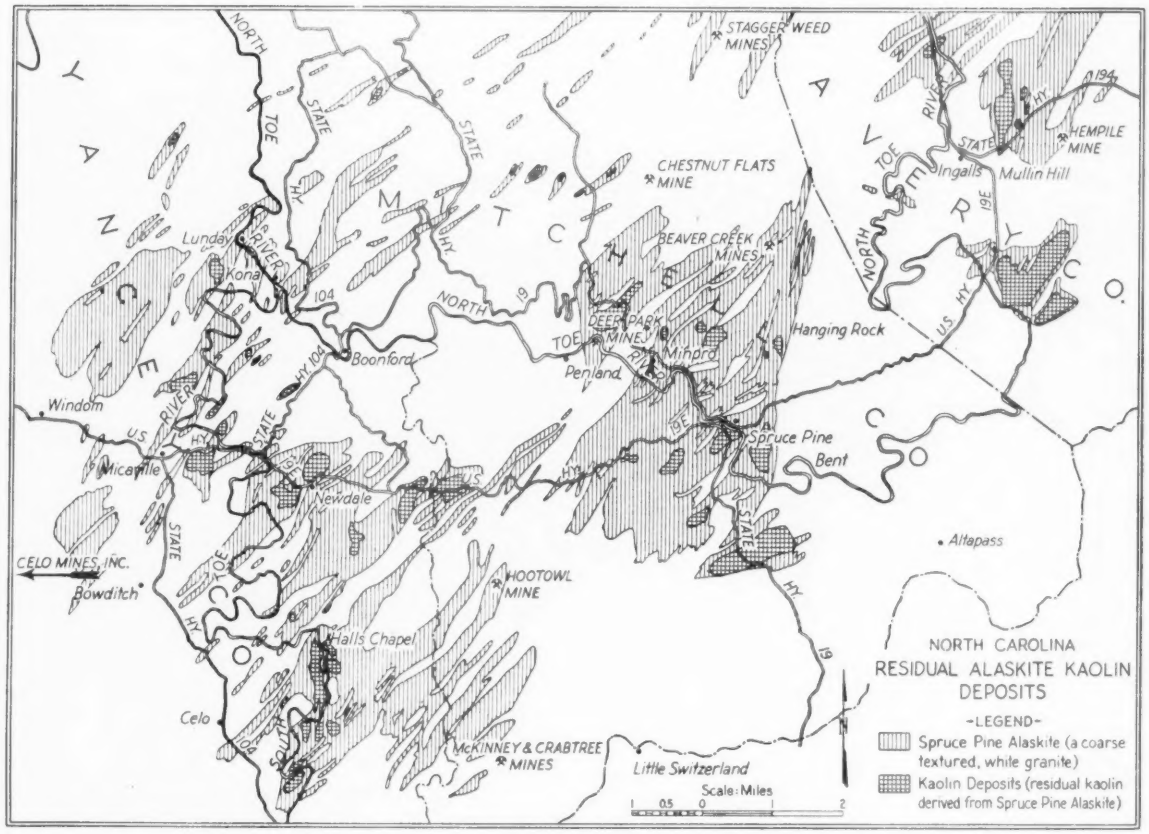


FIG. 1.

and contains feldspar crystals up to one foot in diameter; the mica crystals average about $^1/_2$ inch in diameter, but pieces 8 inches in diameter are not uncommon in the pegmatites. One of the most remarkable things about the alaskite is the almost entire absence of iron-bearing minerals. Occasionally some small spessartite-like (manganese-iron) garnets are found in the alaskite, but hornblende is entirely absent. Biotite, the high iron mica, is rarely found in the alaskite, although it is frequently associated with pegmatite cutting the alaskite.

Most granite and pegmatite contain various titanium minerals. The Spruce Pine alaskite, which contains no noticeable titanium minerals, is an exception, and only a trace of titanium is found in the kaolin derived from this rock.

FIG. 2.—Schist inclusions in kaolin.

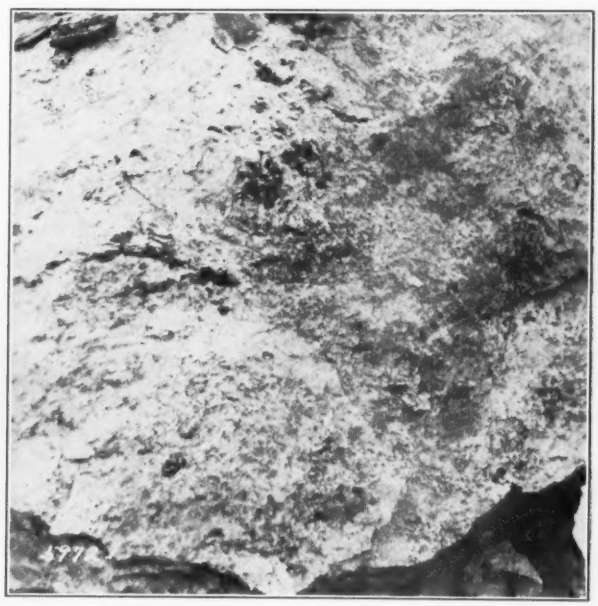


FIG. 3.—Close-up of alaskite.

TABLE I

ANALYSES OF SPRUCE PINE ALASKITE*

	No. 1 (%)	No. 2 (%)
SiO_2	73.96	74.30
Al_2O_3	15.77	15.50
Fe_2O_3	0.33	0.30
CaO	1.30	0.90
K_2O	3.74	4.56
Na_2O	4.57	4.15
Ignition loss	0.31	0.26
Total	99.98	99.97

* Analyses from the Minpro Laboratory, Tennessee Mineral Products Corp., Spruce Pine, N. C.

One of the outstanding facts about the Spruce Pine alaskite is the uniformity of the mineral content. All of the alaskite bodies are essentially of the same composition and texture and are remarkably uniform throughout their extent; the proportion of feldspar, quartz, and mica varies only slightly within the bodies. The alaskite referred to in Table I contains 45.3% plagioclase feldspar, 21.2% microcline feldspar, 28.6% quartz, 2.2% muscovite mica, 0.5% garnet, 1.2% clays, and 1.0% other minerals.† The alaskite contains no minerals that could be orientated easily, but it shows a remarkably high degree of schistosity which is in the form of minute fractures with their planes approximately parallel to the schistosity of the enclosing rocks. These fractures were produced by a slight shearing movement in the granite during the last mountain-making movement in the region, and are important in the kaolinization process because they allow solutions to reach and react with an immensely larger surface of the feldspars.

IV. Pegmatites

It is now understood why geologists for many years have considered these kaolin deposits to be pegmatites. The alaskite bodies contain numerous pegmatites which add to the difficulty of interpreting correctly the complex geology of the Spruce Pine area. Watts[3] states, "At Penland, Mitchell County, North Carolina, a dike in an advanced state of kaolinization is being worked for kaolin, and 50 yards distant a dike containing fresh feldspar is being worked. In this case, however, the kaolin deposit is not well defined and appears to have been disturbed by a slide, whereas the fresh feldspar is in a well-defined dike." Watts therefore realized that there were two distinct types of feldspar-bearing rocks in the Spruce Pine area, but he did not recognize them as pegmatites and coarse-textured granites. The feldspar mine that Watts refers to is a pegmatite, and the kaolin in his reference is of the alaskite type.

Pegmatites are associated everywhere with the Spruce Pine alaskite and are nearly always present along the contacts between the alaskite and the country rock. These pegmatites, which occur within the alaskite bodies, are almost indistinguishable from the surrounding alaskite because they grade into each other and they have a similar composition. The pegmatitic solutions partly recrystallized the alaskite, thus making an indefinite contact between the two. These pegmatites are distinguished from the alaskite by the occurrence of large feldspar and muscovite crystals, by a higher concentration of microcline (potash feldspar), and by quartz veins. Smoky quartz is a common constituent of pegmatites in the area, but it is not found in the alaskite. The alaskite departs from its usual uniformity in local areas of excessive pegmatitic activities. Solutions from the pegmatites have introduced minerals not common to the alaskite, such as biotite. The texture of the alaskite in areas of pegmatitic activities in most cases is exceptionally coarse. Keith[4] states that the pegmatites in this area are late Carboniferous in age.

V. Kaolinization

The essential process in the kaolinization of the alaskite was the removal of the alkali (soda, potash, and lime) from the feldspar and the addition of water. The kaolinization was aided by the humic acid in the meteoric water (rain water) that percolated through the alaskite. This kaolinization process was similar in many respects to laterization, that is, to a special weathering process. At the time of kaolinization of the alaskite in the Spruce Pine area, the rainfall undoubtedly was very heavy and supported abundant and varied plant life. The rainfall is known to have been heavy because the gravel deposits formed by the Toe rivers during the Tertiary Period are of such size and nature that only a stream fed by heavy rainfall could have produced gravel deposits of this kind. The present rainfall and the vegetation in the area are sufficient to furnish the essentials for the kaolinization process. Decaying vegetation furnished a large quantity of humic acid essential to the kaolinization of the alaskite. Some geologists suspect that bacteria played a part in the kaolinization.[5] Even if the bacteria did not play a direct part, bacterial action undoubtedly caused the alteration of the plant remains into carbonic and humic acids. The solution of carbonic and humic acids in the ground water slowly found its way down into the alaskite bodies where it aided in converting the feldspar into kaolin. Kaolinization takes place best where the topographic features encourage underground drainage and where the alaskite is covered by a dense growth of vegetation, such as rhododendron and laurel thickets. Swampy areas of this type are common today in the Spruce Pine area. Examples of such conditions are the Grassy Creek, Gusher's Knob, and Brush Creek areas.

† See * footnote, Table I.

[3] A. S. Watts, *loc. cit.*, p. 17.

[4] (*a*) Arthur Keith, "Mount Mitchell, N. C.-Tenn.," *Folio of Geologic Atlas of U. S.* [U. S. Geol. Surv.], No. 124, 10 pp. (1905); p. 3.

(*b*) Arthur Keith and D. B. Sterrett, "Gaffney-Kings Mountain, S. C.-N. C.," *ibid.*, No. 222, 13 pp. (1931); p. 11.

[5] F. W. Clarke, "Data of Geochemistry," *U. S. Geol. Surv. Bull.*, No. 770, 841 pp. (1924); pp. 488, 496; *Ceram. Abs.*, **4** [8] 230 (1925).

The North and South Toe rivers played a major part in the kaolinization process. Eckel* was the first to point out the existence of several old river terrace levels and old peneplains in the Spruce Pine area, and he considers these terrace levels to be Tertiary in age. By terrace levels is meant elevations at which the river at an earlier time formed a flood plain. Two of the best examples of these terraces are those occurring near Spruce Pine and Ingalls, North Carolina. These terraces, in most cases, are capped with a mixture of rounded and poorly sorted river boulders and pebbles mixed with transported soil. There have been at least three distinct terrace levels in the area which are about 50, 100, and 175 feet, respectively, above the present river bed. Above the third terrace level, some of the topographic features suggest the remains of ancient river levels, but these are not well enough preserved to be termed benches or terraces.

The Tertiary sediments were deposited in broad flat valleys along the North and South Toe rivers as these rivers meandered across swampy flood plains between rugged mountains. The gradient of the river was increased at intervals, thus permitting the river to cut down its channel to lower levels where it again formed a narrower, swampy flood plain which later became another terrace. Many of the terraces were cut in Spruce Pine alaskite. While they were being cut, but chiefly later, meteoric waters percolated down through the joints and schistosity planes in the alaskite of the terraces and attacked the feldspar along its path. This downward percolation of water extended to a depth slightly below the river level at the time of the formation of that particular terrace; that is, the rain water soaked down through the soil and rock underlying the terrace and emerged at the level of the river.

The terraces occurring on the headwaters of the river and back from its course undoubtedly remained as terraces long after the river had cut down to the succeeding levels. These terraces were capped with pervious deposits of sand and gravels, and their level topography discouraged rapid run-off of rain water, causing a high percentage of the rain water to percolate through the underlying alaskite. This permitted the kaolinization processes to continue at an even faster rate and to greater depths through the hanging terraces. Later, streams entering into the river from the sides eroded these hanging terraces and most of the large kaolin bodies under them, thus leaving only remnants of the original kaolin formed in the area. The present existing kaolin deposits in the area occur under the remaining portion of terraces where erosion has not completely removed them.

Inasmuch as many of the kaolin deposits are surrounded by huge alaskite bodies and mica schist which are exceedingly low in iron content, the water that aided in the kaolinization process came in contact with but little iron before entering the zones of kaolinization. This partly accounts for the low iron content in the kaolin deposits. Carbon dioxide in the ground water, however, has a tendency to hold iron in solution and even to remove it in the form of ferrous bicarbonate[6] from the kaolin during the kaolinization process.

Most of the schist and the gneiss occurring at localities bordering the kaolin deposits and points of similar topography, i.e., points protected from rapid erosion, are weathered to depths as great as the depth of kaolinization. Some of the mica schist bodies, however, are more resistant to weathering and remain as hard rock even though the schist is completely surrounded by kaolin.

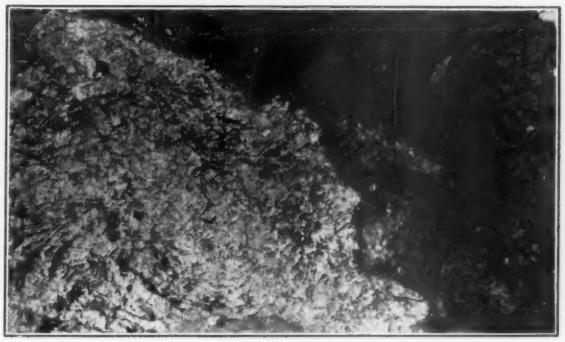


FIG. 4.—Contact between alaskite and schist.

The kaolin deposits contain areas of semikaolinized and even fresh feldspar, and there is a diminishing proportion of kaolin toward the bottom of the deposits. All of the deposits are underlaid at some variable depth by partly weathered, i.e., partly kaolinized, alaskite at levels where possibly the acidity of the water is partly neutralized and where drainage becomes slow. There are also semikaolinized zones that are perhaps related to zones of less fracturing or to topographic features. Either or both of these features would slow down the circulation of the meteoric water. In some cases, surface drainage features, such as impervious clay layers deposited by the streams at the time of the formation of the terraces, probably prevented free descent of rain water, which accounts for some of the semikaolinized areas. The areas containing excessive pegmatites are not usually completely kaolinized because these areas generally contain a higher percentage of potash feldspar which is slightly more stable than soda feldspar.[7] As the pegmatites are later than the alaskite they may not be so thoroughly cracked by the mountain-making movements as the alaskite proper.

The kaolin deposits occurring near the river usually extend down to an elevation slightly below the river level. It should be remembered that the kaolin deposits occurring at some distance from the river and at higher elevation, such as those occurring under the high terrace levels, do not extend down to river level, but the kaolin exists only to a depth at which water has freely circulated. An example of a deposit occurring high above the river and not extending to the depth of the river level is the Gusher's Knob deposit. Semikaolinized material occurs in this deposit at variable depths

* Edwin C. Eckel, Chief Geologist, Tennessee Valley Authority, personal communication.

[6] F. W. Clarke, *loc. cit.*, p. 486.

[7] F. W. Clarke, *loc. cit.*, pp. 482, 493.

from 50 to 200 feet. These higher deposits have a more irregular bottom depth because of the lower bottom limit at which the water could circulate than do those deposits occurring near the river. Near the river, the ground water could circulate only to a short distance below the river bottom, thus causing a more definite bottom zone at which kaolinization ceased.

The kaolin deposits in the Spruce Pine area were carefully examined for evidence of having been formed by hydrothermal solutions (ascending hot waters). No evidence was found to support this type of origin; on the other hand, much evidence was found to prove that the origin was by meteoric waters because the deposits are underlaid by unaltered feldspar and extend only to a depth at which the meteoric water has circulated. There is likewise no kaolin in the high terraces, although it probably once existed and has been washed away.

The author has examined several hundred kaolin deposits occurring from northern Virginia to middle Alabama. Of all these deposits examined, only those occurring at the Chestnut Mountain area of Virginia, and at Dadeville, Alabama, show any indications of having been formed by hydrothermal solutions.

VI. Present Kaolin Deposits

There are more than fifty geographically separate kaolin deposits associated with the Spruce Pine alaskite in Avery, Mitchell, and Yancey counties, North Carolina. The largest and best of these deposits occur under terrace levels produced by North and South Toe rivers and Crab Tree Creek. There are some small deposits, however, occurring at much higher elevations and apart from the river terraces. These deposits, which are not along the main drainage system, usually owe their existence to erosion-resisting schist beds that occurred adjacent to the alaskite. The schist beds served as barriers, preventing the erosion of kaolin after it was formed from the alaskite. The outcrops of the kaolin deposits vary in size from a fraction of an acre to more than one hundred acres. All of the deposits, small or large, contain schist inclusions, zones of semikaolinized feldspar, and a proportion of kaolin which diminishes with depth. Some of the deposits are slightly iron-stained, owing to small pegmatites which contain iron minerals occurring within the alaskite. A few other deposits contain a small amount of iron because the alaskite bodies are surrounded by and contain inclusions of country rock high in iron, such as hornblende gneiss. This is especially true of some of the deposits occurring near the headwaters of the South Toe river. These slightly iron-stained deposits, however, are only a small part of the kaolin reserve in the area. Some deposits also have an organic stain near the surface, especially where rhododendron covers the deposit. This coloring matter disappears on firing the clay.

Practically all of the deposits in the Spruce Pine area contain recoverable kaolin. The deposits rarely occur with objectionable mining features, such as excessive overburden and inaccessible locations. The kaolin in the deposits occurs with residual quartz, muscovite mica, and some semikaolinized feldspar. The mass retains the original structure and texture of the alaskite. The mixture is easily mined by mechanical methods or by a water jet under moderate pressure. The thicknesses of the kaolin deposits vary throughout the area as well as within individual deposits. This is natural for the kaolinization process was dependent upon weathering, and in many places some of the kaolin has been eroded from the top of the deposit. One of the deposits occurring near the town of Spruce Pine is reported to have been mined to a depth of slightly more than 100 feet, at which depth the percentage of unaltered feldspar was sufficiently high to discourage mining for kaolin at a further depth.

TABLE II

ANALYSES OF WASHED KAOLIN SAMPLES*

	No. 1 (%)	No. 2 (%)
SiO_2	47.94	46.18
Al_2O_3	37.02	38.38
Fe_2O_3	0.60	0.57
TiO_2	0.02	0.04
CaO	0.30	0.37
MgO	0.07	0.42
K_2O	1.25	0.58
Na_2O	0.06	0.10
ZrO_2		0.08
Ignition loss	13.03	13.28
Total	100.29	100.00

* Analyses furnished by Harris Clay Co., and Kaolin, Inc., Spruce Pine, N. C.

Several guesses have been made as to the tonnage of the kaolin in the Spruce Pine area. Some of these figures have been so ridiculously high that they defeated their intended purpose. After spending many months in the Spruce Pine area making a geologic map of the entire area with special study on the Spruce Pine alaskite and the kaolin deposits, the author and Phillip W. Mattocks* gathered sufficient data from which an estimate of the total tonnage of crude kaolin reserve was calculated. By "crude" kaolin is meant the kaolin and its accompanying matrix minerals less the schist and gneiss inclusions. The estimate for Avery, Mitchell, and Yancey counties of North Carolina in 1937 was 51,000,000 tons of crude kaolin. The amount of finished kaolin that can be produced from this estimate depends upon the percentage of kaolin in the various deposits and the percentage the processing plants are able to recover. The percentage of recoverable kaolin varies with the various deposits. Many of the deposits have been worked on a 10% or greater recovery basis.[1(b)] A higher percentage than 10% of recoverable kaolin, however, occurs in many deposits.

In addition to kaolin, these deposits contain high-grade muscovite mica, which is recovered and sold as a by-product from the kaolin refining process. Much of this mica is used in the manufacture of roofing and as fillers. Semikaolinized feldspar and quartz constitute

* Formerly Junior Geologist, Tennessee Valley Authority.

most of the remaining tailings from the operations. The quartz is milky white in color, it is free from iron stains, and it meets the qualifications for high-grade glass sand although little use has been made of it for this purpose.

Other residual kaolin deposits occur in North Carolina outside the Spruce Pine area, but most of these are of the pegmatite variety. These deposits are much smaller than those derived from alaskite. In the vicinity of Hayesville, Clay County, North Carolina, about 150 miles southwest of Spruce Pine, occur some outcrops of alaskite similar to those in the Spruce Pine area. The alaskite near Hayesville has kaolinized into irregular deposits of kaolin, but little commercial exploration has been made.

Perhaps it should be restated, in conclusion, that the residual kaolin deposits occurring in the Spruce Pine area were derived from coarsely crystalline alaskite and not from pegmatites. This accounts for the dependable reserve of the deposits, which is important to the users of kaolin. Although kaolin has been produced from this area for more than a half century, its potentialities are not yet generally recognized.

Acknowledgments

The author is indebted to Frank L. Hess, Principal Mineralogist, U. S. Bureau of Mines, whose valuable work on the Spruce Pine alaskite paved the way for this paper. He also gratefully acknowledges the valuable constructive criticism given by H. S. Rankin, Chief, Raw Materials Research Div., Commerce Department, TVA, Knoxville, Tenn.; Hewitt Wilson, Supervisor, Electrotechnical Lab., U. S. Bureau of Mines, Norris, Tenn.; W. F. Prouty, Head of the Geology Dept., University of North Carolina, Chapel Hill, N. C.; and B. C. Burgess, Manager, Tennessee Mineral Products Corp., Spruce Pine, N. C.

Data for this paper were drawn from the Tennessee Valley Authority field work performed in 1936 by Phillip W. Mattocks, Junior Geologist, and the author, under the general supervision of Edwin C. Eckel, Chief Geologist. Lynn L. McMurray, Junior Mining Engineer, Tennessee Valley Authority, assisted with part of the detailed geological mapping and kaolin investigation covered by this paper.

COMMERCE DEPARTMENT
TENNESSEE VALLEY AUTHORITY
NORRIS, TENNESSEE

HISTORICAL DATA ON THE AMERICAN CERAMIC SOCIETY

Year	Meeting Place	President Elect	Vice-President Elect
1899	Columbus, Ohio	H. A. Wheeler (general)	Ernest Mayer
1900	Detroit, Mich.	Karl Langenbeck (general)	C. F. Binns
1901	Old Point Comfort, Va.	C. F. Binns (art)	Ernest Mayer
1902	Cleveland, Ohio	Ernest Mayer (whiteware)	F. W. Walker, Sr.
1903	Boston, Mass.	E. C. Stover (whiteware)	Heinrich Ries
1904	Cincinnati, Ohio	F. W. Walker, Sr. (whiteware)	A. V. Bleininger
1905	Birmingham, Ala.	W. D. Gates (terra cotta)	Ellis Lovejoy
1906	Philadelphia, Pa.	W. D. Richardson (structural clay)	Samuel Geijsbeek
1907	St. Louis, Mo.	S. G. Burt (art)	R. C. Purdy
1908	Columbus, Ohio	A. V. Bleininger (whiteware)	Charles Weelans
1909	Rochester, N. Y.	R. C. Purdy (general)	A. S. Watts
1910	Pittsburgh, Pa.	Heinrich Ries (general)	R. R. Hice
1911	Trenton, N. J.	Charles Weelans (whiteware)	L. E. Barringer
1912	Chicago, Ill.	A. S. Watts (general)	C. W. Parmelee
1913	Washington, D. C.	Ellis Lovejoy (structural clay)	A. F. Hottinger
1914	Wheeling, W. Va.	C. W. Parmelee (general)	D. T. Farnham
1915	Detroit, Mich.	R. R. Hice (structural clay)	R. T. Stull
1916	Cleveland, Ohio	L. E. Barringer (whiteware)	F. K. Pence
1917	New York, N. Y.	G. H. Brown (general)	C. E. Jackson
1918	Indianapolis, Ind.	H. F. Staley (enamel)	A. F. Greaves-Walker
1919	Pittsburgh, Pa.	R. T. Stull (structural clay)	R. H. Minton
1920	Philadelphia, Pa.	R. H. Minton (whiteware)	E. T. Montgomery
1921	Columbus, Ohio	F. K. Pence (whiteware)	F. B. Ortman
1922	St. Louis, Mo.	F. H. Riddle (whiteware)	E. Ward Tillotson
1923	Pittsburgh, Pa.	A. F. Greaves-Walker (refractories)	R. D Landrum
1924	Atlantic City, N. J.	R. D. Landrum (enamel)	R. M. Howe and August Staudt
1925	Columbus, Ohio	E. Ward Tillotson (glass)	F. H. Rhead
1926	Atlanta, Ga.	R. L. Clare (terra cotta)	B. Mifflin Hood
1927	Detroit, Mich.	B. Mifflin Hood (structural clay)	M. C. Booze
1928	Atlantic City, N. J.	M. C. Booze (refractories)	R. R. Danielson
1929	Chicago, Ill.	G. A. Bole (general)	F. A. Harvey
1930	Toronto, Canada	Edward Orton, Jr. (general)	P. E. Cox
1931	Cleveland, Ohio	E. V. Eskesen (terra cotta)	Alexander Silverman
1932	Washington, D. C.	E. P. Poste (enamel)	W. Keith McAfee
1933	Pittsburgh, Pa.	J. C. Hostetter (glass)	L. J. Trostel
1934	Cincinnati, Ohio	W. Keith McAfee (whiteware)	J. M. McKinley
1935	Buffalo, N. Y.	J. M. McKinley (refractories)	F. C. Flint
1936	Columbus, Ohio	F. C. Flint (glass)	R. B. Sosman
1937	New York, N. Y.	R. B. Sosman (refractories)	V. V. Kelsey
1938	New Orleans, La.	V. V. Kelsey (materials)	A. I. Andrews
1939	Chicago, Ill.	A. I. Andrews (enamels)	J. L. Carruthers

CERAMIC HISTORY

LEON J. HOUZE, SR., 1857–1940*

Mr. Leon J. Houze, Sr., for many years recognized leader and builder of industrial communities, died in St. Joseph's Hospital, Albuquerque, N. M., on January 22, 1940. Only a few days earlier he had said goodbye to his eldest son, Norman, and his family, with whom he had visited at their home in Bakersfield, California, following a leisurely automobile trip from his Florida winter home. Until suddenly striken at Albuquerque, Mr. Houze had seemed to be in reasonably good health and spirits, eagerly anticipating his arrival home in Point Marion, Pa.

Mr. Houze was born July 25, 1857, at Marimont, Belgium, the youngest of nine children born to Jean Baptiste ("The Major") Houze and Mary Theresa Wilber Houze. His father was a coal-mine inspector. While attending routine duties deep in the mine shaft he contracted a heavy cold which resulted in his death when his son, Leon, was three years of age. Following an uneventful childhood, limited to a primary school education, Mr. Houze sought and gained employment in a nearby sheet-glass factory. At twelve years of age, he entered apprenticeship to the glassworking trade (probably with one of his older brothers). But the "goings-on" around the glassmaking tank, after the workers had called it a day and left for their respective homes, fascinated him. He loitered around the place, eagerly springing to any task the tank foremen assigned to him. By the time he was approaching his majority he had become a full-fledged window glass blower—and much more. He was by way of becoming an inventor, manufacturer, industrialist as well as capitalist and philanthropist.

He absorbed about everything there was to the art of glassmaking as it was then conducted in his part of the world, and he next confessed to a curiosity as to how the business was being carried on in the New World. He obtained his mother's permission to journey to the United States, seek a job, and see what he could see. He solemnly promised to return home at the end of six months, probably dreaming of learning the American way for use in his native Belgium.

He arrived in the United States in 1879 and immediately obtained employment at his glassblowing trade with the Day-Williams Glass Company, Kent, Ohio. Within a few months, his employer recognized that he had management ability and placed him in charge of the glass production department. Instead of returning to Belgium, he sent word to his brothers to come to America and share his good fortune with him. His mother and two sisters followed later.

In 1881, with his brothers he built the first cooperative window-glass factory in this country, located at Meadville, Pa. He demonstrated that he knew every part of the business, from the founding of a model community of workers to drawing plans and constructing a glass factory, including many innovations heretofore unheard of.

First in many things, in that same year Mr. Houze was the first man to harness natural gas to the manufacture of glass, having built an experimental tank on the site of an old sawmill at Olean, N. Y.

From that time, Mr. Houze's record is replete with a long line of pioneer achievements in the production of white and colored sheet glass, optical and goggle glass, and an endless variety of glass specialties, not to mention the melting tanks, retorts, gadgets, and "jumble of things necessary to the satisfactory production of glass." His introduction of the blow-over furnace which replaced melting pots was a particularly welcome innovation to manufacturers and glass workers alike.

In 1883, Mr. Houze married Miss Elizabeth Cathala of Meadville, Pa. One year later, a son, Norman, was born, at the cost of his wife's life. This son is now a resident of Bakersfield, California.

In 1887, Mr. Houze went to Durhamville, N. Y., to construct a glass factory. There he married Miss Irma Andris, daughter of Robert, Sr., and Anna Andris. To this union, six children were born, all of whom survive. They are Armand L. Houze, Sr., Roger J. Houze, Mae Board, wife of W. H. Board, Sr., Florine Foltz, wife of H. W. Foltz, Marguerite Board, wife of Charles B. Board, and Leon J. Houze, Jr., all of Point Marion. Twelve grandchildren and one greatgrandson also survive. His wife, Irma Andris Houze, died November 20, 1938.

Throughout his long and active life, Mr. Houze designed and built glass factories at Fostoria and Lancaster, Ohio, and at many other points in the United States. In 1899, he came to Point Marion, Pa., where he has since resided, except during short periods in the early 1900's when he left temporarily to build glass factories at Brownsville and Masontown, Pa., and at Salem, W. Va.

During his pioneering years he also found time to devote his inventive genius to devising farm machinery and equipment and oil burners to generate steam for railroad engines.

Following his construction of the Jeannette Window Glass Company plant in Point Marion in 1899–1900, he built a glass factory in Brownsville in 1900–1901. In 1902, a second cooperative company (Federated Glass Company) was formed in Point Marion with Mr. Houze as the president and general manager. Then followed the glass plant at Masontown. In 1914, the Houze Window Glass Company was built at Point Marion with Mr. Houze as the principal owner.

Meanwhile, Mr. Houze, together with his son, Roger, then aged 20, and, some years later, his son Armand, Sr., and sons-in-law, W. H. and Charles Board, directed attention to the production of convex portrait glass, subsequently adding glass specialties, optical glass, and finally colored glass specialties to the rapidly growing business.

* *Point Marion News*, January 25, 1940.

In 1917, the L. J. Houze Convex Company purchased the properties of the Morris Glass Bottle Company, which was converted to the production of convex portrait glass and clock circles.

In 1922–1923, the hand-blown window-glass industry bogged down before the machine process, and the L. J. Houze Convex Glass Company, Inc., purchased the Federated and Houze Window Glass properties, converting them to the production of Houze convex products. New additions to the Convex plants have also been constructed from time to time, until today this Company stands out as one of the greatest of its kind in the entire world.

Today this man has departed our midst, but the memory of his many achievements will be a part of every one who knew him. His successors will carry on from where he left off, of course, but he will be sincerely missed and mourned.

If Mr. Houze's life were to be summed up in a few words, it would be that his chief determination at all times was never to be satisfied with making anything less than the best glass products in the world, working day and night for improved means and methods, and striving unceasingly to know everything about glass production.

OUR MODERN PIONEER MEDALISTS

KARL E. PEILER

Mr. Peiler was born in Hartford, Conn., and after finishing the schools there, he attended the Massachusetts Institute of Technology from which he was graduated in 1904. From 1904 to 1910 he was employed, usually as an engineer, with several different companies.

Awarded to
Karl Ernest Peiler
A Modern Pioneer on the Frontiers of American Industry, in recognition
of distinguished achievement in the field of science and invention
which has advanced the American standard of living
February 1940
Karl T. Compton

In 1910 he became associated with the late William A. Lorenz, a well-known consulting engineer in Hartford. Mr. Lorenz was retained by the Beech-Nut Packing Company, and he assigned Mr. Peiler to an investigation of certain difficulties which the Beech-Nut Company encountered in its glassware. Through his study of the glassware industry, Mr. Peiler discovered an urgent demand for improved methods and machinery for making better ware. His work eventuated in numerous inventions, all aiming at the same object, which was to provide a better method and means to parcel out gobs of molten glass at regular intervals from the mass in a melting furnace and to shape them into the desired forms of glassware.

These inventions gave promise of great value to the glass industry and, therefore, in April, 1912, the Hartford-Fairmont Company was organized for the purpose of promoting the Peiler inventions and such others as might be related thereto. After the usual struggle to perfect and to commercialize new inventions, the Peiler glass feeders were accepted by the glass manufacturers of the United States as the standard means of feeding glass, and they are now in almost universal use throughout the United States and in many foreign countries.

Karl E. Peiler

The Hartford-Fairmont Company became the Hartford-Empire Company in 1922 with Mr. Peiler as chief engineer up to December, 1936, when he became one of its vice-presidents.

Mr. Peiler is the sole inventor in one hundred and forty-seven United States patents relating to the glass business in addition to a large number of other patents in which he is joint inventor with other Hartford engineers; he also has

many foreign patents in seventeen countries. These inventions comprise feeding, conveying, and heat-treating molten glass, forming glassware, glass-tube making, annealing ovens, and the manufacture of ceramic refractories. His best-known invention is what is now called the Hartford single feeder, which employs the same general method of operation as his original invention although of course many improvements have been added.

At the time that Mr. Peiler entered the field, there were only three methods of separating the necessary amount of molten glass to be formed into an article. These were (1) the use of a hand punty or hand blowpipe, which had been used since the time of the early Egyptians; (2) pouring a stream of glass into a mold in the same way that molasses might be poured from a pitcher into a cup; and (3) the Owens machine, which sucked a charge of glass into the mold by a vacuum. Mr. Peiler's invention was distinguished from all of these in that he used glass at a lower temperature and therefore of greater viscosity than was formerly used, and he cut off the necessary amount to form a mold charge while the glass was suspended in the air and practically stationary. These feeders are now used for making a large variety of glassware, including bottles, tableware, glass brick, marbles, and many other things.

Mr. Peiler was made a Fellow of The American Ceramic Society, April 16, 1939. He also is a member of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, Electrochemical Society, and American Chemical Society.

GAMES SLAYTER RECIPIENT OF N.A.M. AWARD

Ohio Inventor of Fiberglas Called Modern Pioneer

Games Slayter of Toledo and Newark, Ohio, who founded the Fiberglas industry by the modern miracle of transforming glass into threadlike fibers, received the award of a "Modern Pioneer" at Cincinnati, Ohio, on February 21, 1940. This award is presented to outstanding inventors and research workers by the National Association of Manufacturers.

Mr. Slayter received the award, together with several other men from Ohio and nearby states, at a banquet held in the Hotel Gibson, Cincinnati. Howard Coonley, chairman of the board of the National Association of Manufacturers, made the address of the evening. The awards to the Modern Pioneers were made in celebration of the 150th Anniversary of the founding of the United States Patent System.

August H. Tuechter of Cincinnati presented the Modern Pioneer Award to Mr. Slayter and the other inventors. In accepting the award, Mr. Slayter stated that he would like to accept it for his organization as well as for himself.

Mr. Slayter is vice-president of Owens-Corning Fiberglas Corporation, Toledo and Newark, Ohio, and is in charge of research and development. At least eight principal United States patents in the Fiberglas field have been issued in his name.

A New Industry Created

The invention of the process of turning glass into fibers has created an entirely new industry which has given employment to hundreds of workers. Although still in its infancy, Fiberglas now is being used extensively by forty-nine industries.

Fiberglas is performing wonders in the field of electrical insulation. Motors, generators, and transformers, which are insulated with Fiberglas, can withstand overloads and the most severe working conditions. Such motors also may be operated at much higher temperatures and consequently may be made much smaller. It is predicted that Fiberglas will revolutionize electrical equipment designs.

Fiberglas is a valuable aid to comfort and convenience in the home. Refrigerators save on electric bills, last longer, and have more uniform temperatures when they are insulated with Fiberglas. Ranges cook better at less cost when they have this insulation. The home itself can be warmer in winter and cooler in summer, with generous slices taken off the fuel bills, when Fiberglas blankets are put in the walls.

Automobile owners are greatly indebted to Mr. Slayter for his invention because battery troubles are minimized when thin, porous sheets of this new material are placed within storage batteries as retainer mats. This development is considered by engineers to be one of the most far-reaching improvements in the construction of batteries since they were first put in automobiles. Standard tests show that these mats double or treble the life of batteries.

Games Slayter, Vice President, Owens-Corning Fiberglas Corporation, Toledo and Newark, Ohio

Used in Ships, Airplanes, and Railroad Cars

Modern ships, airplanes, and streamlined locomotives and cars have found many insulating and other uses for Fiberglas. It is also widely used as filtering and soundproofing media.

As Fiberglas can be twisted into thread and woven into cloth, glass decorative fabrics, which are firesafe, shrinkproof, colorfast, and mildew proof, are the latest products made of this basic material. These include draperies, shower curtains, bedspreads, tablecloths, curtains, and lamp shades. Even a cigarette may burn out its length on this fabric without destroying it, and the resulting stain may easily be removed with soap and water.

Slayter Dreamed of Utilizing Glass

In 1931, Mr. Slayter became associated with what is now the Owens-Corning Fiberglas Corporation as a consulting engineer. He had long dreamed of making glass more flexible and more usable by industry. His efforts were first directed toward the production of new products and new uses for glass and improved machinery for manufacturing glassware. The most important of these developments was in the field of glass wool. Up to that time, glass wool had assumed practically no commercial importance in the United States and very little abroad.

Mr. Slayter conceived the idea of attenuating a series of fine glass streams by means of steam. The principal steam-blowing patent was filed in the names of Games Slayter and his assistant, John H. Thomas, in 1933, and was issued October 11, 1938. This patent contains product, method, and apparatus claims.

The first product manufactured commercially embodying Fiberglas was the Dust Stop air filter. This filter has greatly stimulated air-conditioning equipment for homes, theatres, stores, and factories.

Insulation Made from Fiberglas

The next product produced commercially from Fiberglas was the heat-insulating bat. This product finds its way into many homes under the name of Red Top Building Insulation, distributed by the U. S. Gypsum Company. It also is used to a large extent as insulation for streamlined trains and refrigerator cars, as well as trucks, buses, and airplanes. Refrigerators, stoves, ovens, pipelines, tanks, stills, boilers, turbines, etc., also employ vast quantities of the insulation.

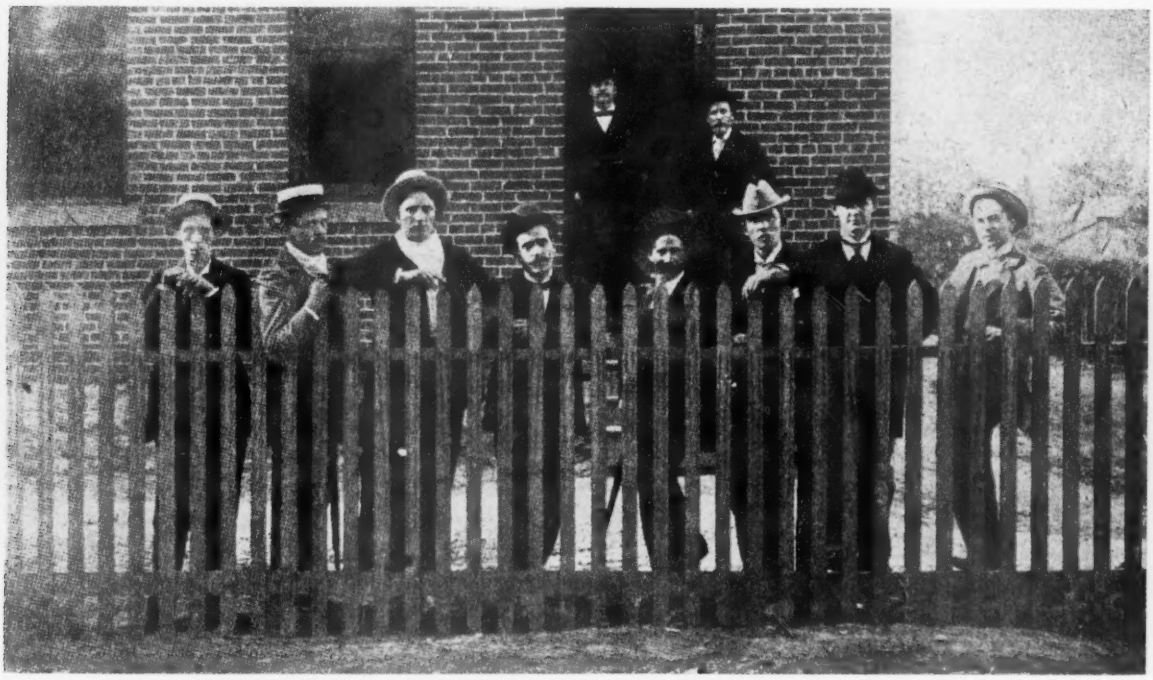
A RETROSPECT AND A PROSPECT*

Editor's Note

In *The Bulletin*, **18** [6] 226 (1939), appeared a print of what supposedly was the first ceramic group picture at Ohio State University. Samuel Geijsbeek has sent in a clipping from *Brick*, published in 1896, which carried the following release written by Professor Edward Orton, Jr. The Industrial Publications, Inc. (present owners of *Brick*) has given permission to use these notes and also furnished the half-tone shown here.

It is evident that the present photograph was limited to those who had completed the two-year "Short Course." Bleininger, Worcester, DeLong, Adams, and Freeman evidently came at the beginning of the second year (1896) of the ceramic school and therefore were the "freshmen," whereas the others were the "graduates" in the group picture as shown in the June, 1939, *Bulletin*.

Of interest also is the fact that in the fall of 1897 the first of the "freshmen" came to register for a four-year course, namely, Barringer, Fickes, Purdy, and Gates.



First Class in Ceramics at Weller's Pottery, Zanesville, Ohio

Reading from left to right, front row: Samuel Geijsbeek, J. W. Wolfley, Carl Giessen, E. F. Braddock, D. C. Thomas, E. J. Jones, Edward Orton, Jr., E. E. Gorton; in doorway, left, S. A. Weller; right, W. A. Long.

Letter from the Clayworkers' School
By Professor Edward Orton, Jr.

The close of the second year of the Clayworkers' School occurred at the Ohio State University on the 17th of June, 1896. Among the great collection of technical information furnished by the modern trade journals to their constituents, a simple announcement like the above would hardly be likely to attract more than a casual glance from the majority of their readers. And yet, unpretentious as is the statement, the facts which it represents cannot be classified as unimportant, for this event marks the welding of one more important link in the chain which shall finally place on the American clay industries the crown of international supremacy.

The school originated in the efforts of a committee of the Ohio Brick Tile and Drainage Association, who made an appeal to the legislature of Ohio in the spring of 1894; this appeal was favorably considered. The matter took shape finally in the creation of a Department of Ceramics in the Ohio State University to be maintained for the period of two years by a special appropriation for that purpose.

The school was organized and thrown open to the public in the succeeding September and, during the year following, the equipment of laboratories and museum went vigorously forward.

The course of study which was thus suddenly and unexpectedly thrown open to the public was made very simple and elementary. In fact, it was an industrial course rather than a technical course, for, realizing the total lack of previous educational training in the industry and also

* From *Brick*, July, 1896.

the fact that a vast number of clayworkers did not believe or admit that special education was applicable to the problems of their business, it was deemed, by all who had the success of the matter at heart, unwise to attempt more than a very simple beginning.

With such objects and such an organization and offering such opportunities, the school has passed its first two years of life. And now comes the critical period of its existence. So far, the problems have been those of organization, equipment, management, courses, etc., and these points have been in the hands of those whose dearest pleasure has been found in their wise settlement. But what is this school for? What is any school for? You will answer readily enough, "for the training and education of its pupils."

Yes, and by what means will its success or value be measured? Solely by one thing—its fruits. If it can be shown that it has given good training, that its students are active-minded, broad, energetic young fellows, full of interest and enthusiasm in their business, and possessing a good knowledge of the principles of any and all branches of the clayworker's art, that they are capable of throwing into their daily work the knowledge thus won, and that by this knowledge they can avoid the mistakes of others who have preceded them and can confine their activities within the limits of the attainable instead of being diverted by every passing speculation which comes to their ears—if these things are once found to be the case, then the prosperity of the school is assured.

But its success and its reputation are in the hands of its graduates. No matter how fine may be its course of instruction, how complete its equipment, or how good its opportunities, if its pupils do not possess the adaptability and the common "horse sense" which will enable them to use that which they have learned, then it will be a failure, and the nearer it comes to attaining this mark without reaching it, the worse will its failure be felt.

In view of these facts, the curiosity of the friends of the school may well be aroused to know something of the young men on whom this responsibility will fall. The names are given of those who have completed the two-year course, as laid down in the official catalogue of the school, and who hold certificates of this fact.

In the regular course are Elmer E. Gorton, Tonawanda, N. Y.; John W. Wolfley, Delaware, Ohio; Carl Giessen, Canton, Ohio; Edward J. Jones, Zanesville, Ohio; David C. Thomas, New Straitsville, Ohio; and Everett F. Braddock, Richfield, Ohio.

In addition to this list, one special student, who has not taken the regular course as laid down but who has done all the advanced work which was within reach at this time, deserves honorable mention for his excellence, viz., Samuel Geijsbeek, Cincinnati, Ohio.

This list of seven names represents the hard workers, the faithful and earnest students out of a total registration of twelve for this class; those who have not completed the course have shown inaptitude for the work and have withdrawn before reaching the end.

ACTIVITIES OF THE SOCIETY

CHAUNCEY E. FRAZIER CAMERA CLUB AWARD

As an added incentive to advance the art of photography to a greater degree among members of The American Ceramic Society, the Frazier family, in honor of husband and father, Chauncey E. Frazier, president of Frazier-Simplex, Inc., will give a yearly award to the member exhibiting the outstanding photographic print at the Ceramic Camera Club Annual Salon.

This paramount trophy for amateur photographers is a beautifully engraved plaque, $7^3/_4$ inches wide, $10^1/_2$ inches long, and about $^1/_2$ inch thick, made of Steuben glass and designed by Frederick Carder, Art Director of the Steuben Division of the Corning Glass Works.

It will be possible to win this trophy but once. Should any member be so signalized a second time, a cash award will be given in lieu of the trophy.

The presentation of the Chauncey E. Frazier Award will be made at the annual dinner meeting of the Ceramic Camera Club on Monday evening, April 8, 1940, at 7:00 P.M. in the Royal York Hotel in Toronto. Francis C. Flint, past-president of The American Ceramic Society, who is serving as Chairman of the Award Committee for 1940, will present the award. Other members of this Committee are Charles D. Spencer of the General Electric Co., Cleveland, Ohio, and Frederick H. Rhead of the Homer Laughlin China Co., Newell, W. Va.

CERAMIC CAMERA CLUB EXHIBIT IN TORONTO

Members of The American Ceramic Society who desire to exhibit photographic prints at the Second Annual Salon of the Ceramic Camera Club to be held in conjunction with the Annual Meeting of The American Ceramic Society at the Royal York Hotel, Toronto, Ontario, on April 7 to 13, 1940, should write for a formal entry blank to J. Earl Frazier, Secretary-Treasurer, Ceramic Camera Club, c/o Frazier-Simplex, Inc., Washington, Pa.

All members of the Ceramic Camera Club will be sent an entry form without request. Information on how to get prints in and out of Canada will be explained and the final date for entries to be accepted will also be given.

Members of The American Ceramic Society who expect to take photographic equipment, such as cameras, light meters, and lenses into Canada may avoid a great deal of delay by having a bill of sale for such equipment, listing camera number, lens number, name, etc. If it is not possible to obtain a bill of sale, the next best thing is to get some good photographic dealer to make an appraisal of the equipment with detailed information on camera, lens, name, etc. This appraisal paper should be available for inspection in Canada.

The Ceramic Camera Club will pay the return postage on all photographs entered or mailed to it for exhibition purposes in Toronto.

There are six general divisions of the Ceramic Camera Club for exhibition judging, viz., portrait industrial, trade paper, scientific, action, color, and pictorial.

The only requirement for entry other than nice photographs, mounted vertically on 16- by 20-inch mounts, is that the exhibitor must be a member of The American Ceramic Society. He need not be a member of the Ceramic Camera Club.

The present members of the Board of Governors of the Ceramic Camera Club are *Chairman*, J. M. McKinley; E. L. Hettinger, I. W. Schoeninger, John R. Hostetter, and *Secretary-Treasurer*, J. Earl Frazier.

PENNSYLVANIA GERMAN POTTERY ADDED TO THE SOCIETY OFFICE EXHIBITS

Mrs. C. Naaman Keyser, Brookcroft, Plymouth Meeting, Pa., has submitted additional examples of her Pennsylvania German pottery to the rapidly growing exhibit at the executive offices of The American Ceramic Society. Of this ware, Mrs. Keyser gives the following description (from a letter dated January 7, 1940).

"The polychrome salad bowl design is from an early weaving. The red, black, and white clay are natural, the red and black being Pennsylvania clays.

"The sgrafitto bowl says, 'Blessed is he who hungers and thirsts after righteousness.' 'Many try to paint flowers but only God gives them fragrance.'

"The tulip signifies love or fertility; the pine tree, health; the laurel, honor; the wheat, prosperity; the

waving lines, the life line; the tree is the tree of life; and the bird is the bird of paradise. The whole signifies a progression from earth, blade, and flower seed.

"The slip bowl says, 'Let it be known that I am what I am—this is true.'

"Both the sgrafitto and the slip are adaptations from ware in our Pennsylvania Museum."

Photographs of Mrs. Keyser's ware and a story of her work appeared in the February *Bulletin*, pp. 85–86 (1940).

NEW MEMBERS FOR FEBRUARY

Corporation

CAMP BROTHERS CO., H. H. Camp (voter), Mogadore, Ohio.

OREFRACTION, INC., Basil Horsfield (voter), 7505 Meade St., Pittsburgh, Pa.

Personal

BELL, LEONARD J., Georgetown, Ontario, Canada; manager, Georgetown Clay Products, Ltd.

CAMERON, HUGH, 17, Monmouth Rd., Hayes, Middlesex, England; foreman, Gramophone Co., Ltd.,

CLAPHAM, CHARLES H., 745 Grape St., Vineland, N. J.; chemical engineer, Kimble Glass Co.

EGEA, LOUIS S., Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.; sales engineer.

GOODELLE, RICHARD H., Northville, N. Y.; assistant manager, Atlas-Feldspar Corp.

GORT, WALTER A., 52 Spring St., Metuchen, N. J.; ceramic engineer, General Ceramics Co.

*GREEN, JOHN R., Brown Instrument Co., 86 South 26th St., Pittsburgh, Pa.; manager.

HAWKINSON, JOHN L., 175 Bartholomew Ave., Hartford, Conn.; designer and manufacturer.

HENDRICKSON, V. E., 200 Virginia Ave., Aspinwall, Pa.; salesman, National Gypsum Co.

LEWIS, WARREN R., 202 Hawthorn Rd., Baltimore, Md.; supervisor, Quality Control Committee, Calvert Distilling Co.

*MATSON, FREDERICK R., 4016 Museums Bldg., Ann Arbor, Mich.; assistant curator of ceramics, Museum of Anthropology, University of Michigan.

MCCORMICK, JOHN M., 210 N. Washington St., Butler, Pa.; engineer, Preston Laboratories.

RIEGGER, HAROLD E., 2302 Delancey St., Philadelphia, Pa.; instructor, Philadelphia Museum School of Industrial Art.

SANT, ROBERT T., Box 55, East Liverpool, Ohio; vice-president, Thomas H. Sant & Son Co.

SNOW, ROLAND B., Research Lab., U. S. Steel Corp., Kearny, N. J.

STEENCKEN, JOHN J., 326 Drew St., Baltimore, Md.; sales and service engineer, Porcelain Enamel & Mfg. Co.

VOLZER, JOSEPH M., 226 Montrose Ave., N. W., Canton, Ohio; metallurgist, Republic Steel Corp.

ZARBO, GEORGE, Fenimore St. near Second, Vineland, N. J.; analytical chemist, Kimble Glass Co.

Student

Georgia School of Technology: F. M. BRISTOL, C. W. BRYANT, JR., A. P. CARPENTER, L. L. CLARK, GABRIEL GALINDO, A. B. JOHNSON, C. R. JUSTI, JR., E. T. MITCHELL, E. E. STOTT, and F. L. WALKER.

Iowa State College: KEITH D. BARTELS and MURNER E. THOR.

New York State College of Ceramics: ALFRED L. PLOETZ and EDGAR J. ROOK, JR.

University of North Carolina: WILLIAM C. CRESS and HALFRED F. RANDOLPH.

Ohio State University: WILLIAM J. SCHARFENAKER.

*Indicates former member of The Society rejoining.

MEMBERSHIP WORKERS' RECORD

Corporation

D. A. Moulton	1	J. H. Stewart	1

Personal

A. I. Andrews	2	W. R. Malkin	1
R. S. Bradley	1	Wilfrid Mavor	1
M. L. Fosdick	1	R. B. Sosman	1
A. F. Greaves-Walker	1	Hans Thurnauer	1
J. F. Greene	2	H. G. Wolfram	1
R. B. Ladoo	1	Office	5

Student

Wayne Brownell	1	Lane Mitchell	10
C. M. Dodd	2	Willard Packman	1
A. F. Greaves-Walker	2	Ralston Russell, Jr.	1
		Grand Total	**37**

ROSTER CHANGES DURING FEBRUARY*

Corporation

RICHARD C. REMMEY SON CO., John G. Remmey (voter), Hedley St. and Delaware River, Philadelphia, Pa. (formerly in name of G. Bickley Remmey)

Personal

CAMP, R. ELDRIDGE, 329 College, Macon, Ga. (Tallahassee, Fla.)

COLE, WILLIAM G., JR., Ferro Enamel Corp., 4150 East 56th St., Cleveland, Ohio (Ottawa, Ontario, Canada)

DUPLIN, VICTOR J., JR., 75 Madison Ave., Lynbrook, L. I., New York (Augusta, Ga.)

FRANCISCO, ALLEN C., 2920 Ontario Rd., N. W., Apt. 103, Washington, D. C. (Raleigh, N. C.)

HAYNES, JACK C., 226 Stanley St., Maryville, Tenn. (Winston-Salem, N. C.)

JORDAN, SUZANNE, Sterling House, Community Center, Stratford, Conn. (Columbus, Ohio)

KREIDL, EKKEHARD, 609 Central Ave., Dunkirk, N. Y. (State College, Pa.)

MANSUR, HOWARD H., Gladding, McBean, & Co., Renton, Wash. (Lincoln, Calif.)

REIMERS, JOHN C., Pfaudler Co., Taylor St., Elyria, Ohio. (Leven, Fifeshire, Scotland)

ROUP, ROLLAND, 5535 Forbes St., Pittsburgh, Pa. (Milwaukee, Wis.)

UPTON, LEE O., 296 Genessee Park Rd., Rochester, N. Y. (Sharon, Pa.)

*Address in parentheses is former address.

CELO KYANITE

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BURNSVILLE, NORTH CAROLINA

HISTORY IS BEING MADE

1940 MEMBERSHIP RECORD

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 20, 1936	1452	196				
December 22, 1937	1713	220	12	523	220	2688
December 19, 1938	1815	222	26	589	220	2872
December 19, 1939	1876	237	27	642	220	3002
January 22, 1940	1930	244	23	656	220	3073
February 20, 1940	1972	243	30	669	220	3134

▲ **These charted Membership Data are net with the resignations subtracted and the new paid Members added.**

▲ **The unpaid Members for 1939 are not counted. Several of them are now paying in full for both years.**

▲ **388 Personal and 25 Corporation Domestic Members and 124 Personal and 7 Corporation Foreign Members on February 20 had not paid 1940 dues nor had they resigned. These are counted as "paid" because payments are being received daily.**

▲ **March 20 is the "dead line" for those who have delayed their payment of dues. Those not paid on that date will be cut off the mailing list. This will be reflected in the "Paid Membership" chart of March 20 because delinquents do not count.**

▲ **History Will Be Repeated. The March 20 number of newly paid Members will be more than the number of delinquents.**

▲ **35 new Personal and 2 new Corporation Members paid in February. The March class of new Members will be larger.**

CONDENSED BALANCE SHEET AMERICAN CERAMIC SOCIETY

December 31, 1939

(For Audit Report of The Society for 1938, see *Bull. Amer. Ceram. Soc.*, **18** [3] 106 (1939))

ASSETS	
Cash	$ 8,330.33
Invested	11,861.16
Receivable	2,023.73
Prepaid	66.44
Total	$22,281.66
LIABILITIES	
Payable	$ 903.33
Earmarked	4,108.12
Unearned income	10,064.95
Total	$15,076.40
SURPLUS	$ 7,205.26

Note: Book stocks, fixtures, equipment, supplies, library, exhibits, and framed photograph gallery are not listed on the balance sheet as assets.

THE EDWARD ORTON, JR., CERAMIC FOUNDATION CONDENSED BALANCE SHEET

December 31, 1939

(For the 1938 Balance Sheet of the Edward Orton, Jr., Ceramic Foundation, see *Bull. Amer. Ceram. Soc.*, **18** [3] *p. 20, Ad Section* (1939))

ASSETS	
Liquid	$ 20,821.09
Finished cones and materials	19,049.74
Prepaid items	462.03
Land, building, and equipment	101,969.90
Total	$142,302.76
LIABILITIES	
Current	$ 734.63
Fellowships	1,000.00
Annuities	50,612.13
NET WORTH	$ 89,956.00
Total	$142,302.76

NOMINATIONS FOR SOCIETY OFFICERS, 1940–1941

THE AMERICAN CERAMIC SOCIETY

President: J. L. CARRUTHERS, Dept. of Ceramic Engineering, Ohio State Univ., Columbus, Ohio.

*Vice-President**

C. E. BALES, Ironton Fire Brick Co., Ironton, Ohio.

J. T. LITTLETON, Corning Glass Works, Corning, N. Y.

Treasurer: C. FORREST TEFFT, Claycraft Co., Columbus, Ohio.

FELLOWS

*Dean**

HEWITT WILSON, Electrotechnical Lab., Bureau of Mines, Norris, Tenn.

EDWARD SCHRAMM, Onondaga Pottery Co., Syracuse, N. Y.

*Associate Dean**

T. A. KLINEFELTER, National Bureau of Standards, Washington, D. C.

HOWELLS FRÉCHETTE, Mines Branch, Dept. of Mines, Ottawa, Ontario, Canada.

Secretary-Treasurer: T. N. MCVAY, Dept. of Chemistry, Univ. of Alabama, University, Ala.

*Nominating Committee A**

G. W. MOREY, Geophysical Laboratory, Washington, D. C.

H. E. WHITE, Lava Crucible Co. of Pittsburgh, Pittsburgh, Pa.

*Nominating Committee B**

R. A. HEINDL, National Bureau of Standards, Washington, D. C.

A. V. BLEININGER, Homer Laughlin China Co., Newell, W. Va.

INSTITUTE OF CERAMIC ENGINEERS

President: H. G. WOLFRAM, Porcelain Enamel & Mfg. Co., Baltimore, Md.

*Vice-President**

E. H. FRITZ, Westinghouse Electric & Mfg. Co., Derry, Pa.

J. T. ROBSON, Allied Engineering Co., Cleveland, Ohio.

*Secretary**

H. M. KRANER, Research Dept., Bethlehem Steel Co., Bethlehem, Pa.

ROBERT TWELLS, Electric Auto-Lite Co., Auto-Lite Spark Plug Div., Fostoria, Ohio.

*Nominating Committee A**

HEWITT WILSON, Electrotechnical Lab., Bureau of Mines, Norris, Tenn.

G. R. SYLVESTER, Allied Engineering Co., Cleveland, Ohio.

*Nominating Committee B**

L. C. HEWITT, Laclede-Christy Clay Products Co., St. Louis, Mo.

J. S. GREGORIUS, Pittsburgh Plate Glass Co., Creighton, Pa.

CERAMIC EDUCATIONAL COUNCIL

*President**

C. W. PARMELEE, Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

M. E. HOLMES, New York State College of Ceramics, Alfred, N. Y.

*Secretary**

F. H. NORTON, Dept. of Physics, Massachusetts Inst. of Technology, Cambridge, Mass.

P. G. HEROLD, Missouri School of Mines, Rolla, Mo.

ART DIVISION

Trustee: L. E. BARRINGER, General Electric Co., Schenectady, N. Y.

Chairman: H. S. NASH, Ceramics Dept., Univ. of Cincinnati, Cincinnati, Ohio.

Vice-Chairman: K. E. SMITH, Ceramic Dept., Newcomb College, New Orleans, La.

Secretary: C. C. ENGLE, United Clay Mines Corp., Trenton, N. J.

Nominating Committee A: MYRTLE M. FRENCH, 800 S. Halsted St., Chicago, Ill.

Nominating Committee B: PAUL E. COX, 307 Audubon St., New Orleans, La.

* One to be elected.

ENAMEL DIVISION

*Trustee**

J. E. HANSEN, Ferro Enamel Corp., Cleveland, Ohio.
R. M. KING, Dept. of Ceramic Engineering, Ohio State Univ., Columbus, Ohio.

Chairman: J. D. TETRICK, Baltimore Enamel & Novelty Co., Baltimore, Md.

Secretary: D. G. BENNETT, Mellon Institute, Pittsburgh, Pa.

Nominating Committee

R. L. FELLOWS, Chicago Vitreous Enamel Product Co., Cicero, Ill.
R. R. DANIELSON, Metal & Thermit Corp., Carteret, N. J.

Councillors

W. H. PFEIFFER, Engineering Lab., Plant 2, Frigidaire Div., General Motors, Dayton, Ohio.
R. D. COOKE, 237 E. Cass St., Joliet, Ill.

MATERIALS AND EQUIPMENT DIVISION

Chairman: B. T. BONNOT, The Bonnot Co., Canton, Ohio.

Vice-Chairman: WALTER H. EMERSON, Homer Laughlin China Co., East Liverpool, Ohio.

Secretary: SANDFORD S. COLE, Titanium Pigment Co., South Amboy, N. J.

Nominating Committee A: WILLIAM R. MALKIN, B. F. Drakenfeld & Co., Inc., East Liverpool, Ohio.

Nominating Committee B: H. R. STRAIGHT, Straight Engineering Co., Adel, Iowa.

REFRACTORIES DIVISION

Trustee: JOHN D. SULLIVAN, Battelle Memorial Inst., Columbus, Ohio.

Chairman: J. B. AUSTIN, U. S. Steel Corp., Research Lab., Kearny, N. J.

Vice-Chairman: GILBERT SOLÉR, Steel & Tube Div., Timken Roller Bearing Co., Canton, Ohio.

Secretary: R. S. BRADLEY, A. P. Green Fire Brick Co., Mexico, Mo.

Nominating Committee A: G. A. BOLE, Edward Orton, Jr., Ceramic Foundation, Columbus, Ohio.

Nominating Committee B: S. M. PHELPS, Mellon Inst., Pittsburgh, Pa.

STRUCTURAL CLAY PRODUCTS DIVISION

Chairman: H. Z. SCHOFIELD, Engineering Expt. Station, Ohio State Univ., Columbus, Ohio.

Vice-Chairman: J. H. ISENHOUR, Isenhour Brick & Tile Co., Salisbury, N. C.

Secretary: L. R. WHITAKER, Richland Shale Products Co., Richtex, S. C.

Nominating Committee A: R. L. STONE, Hale Manufacturing Co., Mount Airy, N. C.

Nominating Committee B: T. W. GARVE, 314 King Ave., Columbus, Ohio.

WHITE WARES DIVISION

Chairman: HARRY THIEMECKE, Homer Laughlin China Co., Newell, W. Va.

*Secretary**

R. RUSSELL, JR., Engineering Expt. Station, Ohio State Univ., Columbus, Ohio.
J. R. KAUFFMAN, Dept. of Ceramics, Rutgers Univ., New Brunswick, N. J.

Nominating Committee A: L. E. THIESS, Porcelain Dept., General Electric Co., Schenectady, N. Y.

Nominating Committee B: DAVID C. ZIMMER, Patterson Refractories Co., East Liverpool, Ohio.

* One to be elected.

NECROLOGY

MRS. W. E. S. TURNER

Many of our readers will learn with deepest regret of the sudden death on December 18, 1939, of Mrs. W. E. S. Turner, the wife of Professor W. E. S. Turner, Sheffield, England. Professor Turner has his own special place in the world of glass and glass technology because of his knowledge, and so had Mrs. Turner hers because of her charm and her happy way of creating and cementing friendships. With Mollie Turner present, any social function in the British glass world could be sure of at least one bright spot, and many of the members of The American Ceramic Society who visited England also came to know her and count her as a friend. She had traveled with her husband to the States and Canada in 1924, to Australia, New Zealand, and South Africa in 1934–1935, and often in Europe, and had a host of friends who will regret her passing.

LOCAL SECTIONS

MICHIGAN-NORTHWESTERN OHIO SECTION

A dinner meeting of the Michigan-Northwestern Ohio Section was held on February 9 at the Medea Hotel, Mt. Clemens, Mich. Despite the icy roads, a good crowd gathered to hear A. B. Curtis, research engineer of the Johns-Manville Company. A sound movie on insulation, the revised edition of the one shown at the World's Fair, was presented. Slides and a discussion were given after the picture. The importance of figuring the proper amount and kind of insulation to be used on each job was stressed by Mr. Curtis.

SOUTHERN CALIFORNIA SECTION

The Southern California Section of The American Ceramic Society held its annual business meeting on February 20 at the Clark Hotel in Los Angeles, Calif. The following officers were elected for 1940:

Chairman: F. A. McCann, Pacific Clay Products Co., Los Angeles, Calif.

Vice-Chairman: J. G. Stewart, Braun Corp., Los Angeles, Calif.

Secretary-Treasurer: J. E. Stevens, Emsco Refractories Co., South Gate, Calif.

Larry Pendroy gave an interesting report of his recent tour of eastern whiteware and pottery plants.

Roy E. Martindale, petrographer, presented an illustrated lecture on "Microscopic Analysis as Applied to Minerals." Through a unique setup, Mr. Martindale projected thin sections on the screen directly from the microscope, showing clearly the various steps in classifying minerals.

A color moving-picture showing the process of making a thin section was presented by Donald Mulvey.

—J. E. STEVENS, *Secretary-Treasurer*

ART DIVISION AND PITTSBURGH SECTION JOINT MEETING

In spite of the worst blizzard since 1910 in the Pittsburgh district, members of the Art Division and the Pittsburgh Section rallied to the all-day sessions of the meeting held on February 13. These members represented not only the Pittsburgh district, but the Washington and Beaver Falls, Pa., East Liverpool and Steubenville, Ohio, and Wheeling, W. Va., districts. The meetings were held at Mellon Institute and the University of Pittsburgh.

The following committees served for the preparation of

this meeting: Ernest Hommel, *General Chairman;* Dwight Bennett, *Assistant Chairman;* J. P. Thorley and Theodore Lenchner, *Program Chairmen;* and Clyde L. Thompson, *Dinner Chairman.*

The officers of the Pittsburgh Section are J. R. Beam, *Chairman,* and G. J. Bair, *Secretary.*

The officers of the Art Division are L. E. Barringer, *Trustee;* J. P. Thorley, *Chairman;* Theodore Lenchner, *Vice-Chairman;* and C. C. Engle, *Secretary.*

Members attending the meeting on Tuesday morning were shown the following exhibitions at the University of Pittsburgh: (1) Eighth National Ceramic Exhibition, (2) the Heinz Memorial Chapel with its stained glass windows by C. J. Connick, (3) the Thirtieth Annual Exhibition of Painting, Sculpture, and Graphic Arts by the Associated Artists of Pittsburgh at Carnegie Institute, and (4) the Stephen C. Foster Memorial.

On Tuesday afternoon, a symposium on "Studio Potters and Ceramic Art Education" was held in the Mellon Institute auditorium. J. Palin Thorley was Chairman of this session and the following program was presented:

(1) Welcome by Walter Read Hovey, Dept. of Fine Arts, Univ. of Pittsburgh.

(2) "Excavations at Tell Beit Mirsim," by Dr. Kelso, American School of Oriental Research.

(3) "Modern Grecian Glass," by Alexander Silverman, Dept. of Chemistry, Univ. of Pittsburgh.

(4) "Creative Development in the Dinnerware Industry," by M. V. Broomhall, Edward M. Knowles China Co.

(5) Demonstration of Pottery Processes: Throwing and Jiggering, by Leonard Brindley and James F. Clutter, Ceramics Division, Cathedral of Learning.

At the afternoon session more than 200, including students of the University of Pittsburgh, were in attendance.

The banquet held in the Imperial Room, Hotel Webster Hall, at 6:30 P. M., was attended by 135 persons. Dean Edward Steidle, School of Mineral Industries, Pennsylvania State College, served as toastmaster. Dean Steidle outlined the ceramic work at Penn State and introduced the guest speaker of the evening, A. I. Andrews, of the University of Illinois and President of The American Ceramic Society.

Dr. Andrews gave a comprehensive and interesting talk on the work of The American Ceramic Society for its members and its value to any persons who are in the ceramic business. He also described the rapid advances being made in the various branches of the ceramic industry. At the close of this talk, Dr. Andrews showed a movie film of his trip to the West Coast meeting last summer.

Before the dinner meeting was ended, close to four hundred members were gathering at Mellon Institute auditorium for the evening session, and although the dinner-meeting crowd and speakers were delayed, they waited patiently for the scheduled program.

The speakers at the evening session were Waylande Gregory of New York, N. Y., whose subject was "Ceramic Sculpture"; Don Hadley, of the Western Electric and Manufacturing Company, "Design Pays Dividends"; and Daniel Boza, "Porcelain Enamel Murals." All of these talks were illustrated with slides and exhibits.

The snowstorm outside and the unavoidable delay in starting the evening session resulted in a pleasing informality not only in the speakers but in the enthusiastic audience. The session was ended at about 11:30 P.M.

SCHOOL NOTES

OHIO STATE UNIVERSITY

Members of the Ohio State University Student Branch of The American Ceramic Society met in Lord Hall on February 20. Mr. Slemmons of the American Blower Corporation, who spoke on "The Use of Fans in the Ceramic Industry," discussed the fundamentals in the operation, application, and theory of fans and gave a detailed description of their use in the glass industry.

Plans were discussed for Engineers' Day. The Ceramic basketball team was announced as runner-up in the Intramural League.

Following the adjournment of the formal meeting, refreshments were served.

—Donald E. Postlewaite, *Secretary-Treasurer*

UNIVERSITY OF WASHINGTON CERAMIC STUDENTS

The Thirteenth Annual Mining Institute of the University of Washington College of Mines was held January 15 to 20, 1940. Of interest to ceramic students were talks on "Porcelain Enamels," by Wendell P. Keith of the Ceramic School faculty; "Pacific Northwest Diatomite," by Roy E. Swift, who holds a Graduate Fellowship; and "Occurrence and Characteristics of Clays," by Marion D. Saindon of the Chehalis Brick & Tile Company.

Additional talks were given by John Bell, a Graduate Fellow, who pointed out the increasing importance of the extensive deposits of high-grade olivine found in the Northwest, and by Carl H. Zwermann, head of the Ceramic School, who addressed an audience of three hundred interested students and engineers on "Glass and Its Uses."

Kenneth McBreen has been elected chairman of a committee to formulate plans for the biennial Engineer's Open House to be held early in April. Black-glazed ash-trays in the shape of a "W" have been selected for souvenirs of the Open House and are being put into production.

—Paul Howell Marmont, *Secretary*

IOWA STATE COLLEGE

The Iowa State College Student Branch of The American Ceramic Society held its first evening meeting of the winter quarter on January 24, 1940.

The speaker was C. T. Bridgman of the Structural Clay Products Institute, who explained in detail the work of the Institute. He also described and illustrated with colored slides the relation of structural clay products to the trends of modern architecture. The need for good sales engineers in the structural clay products field was also emphasized as a means of presenting the possibilities of ceramic products to the people.

In the business meeting, plans were discussed and committees were appointed for the Ceramic Engineers' Open House during the three-day Veishea Exhibit of Iowa State College. At present, molds are being made for ash trays of modern design which will be offered to the Open-House visitors.

—Maurice W. Gormly, *Corresponding Secretary*

SIXTH CONFERENCE ON GLASS PROBLEMS MAY 10 AND 11

To Be Held at the Department of Ceramic Engineering, University of Illinois

A Glass Conference, the sixth in the series which have been given from time to time under the joint auspices of the Department of Ceramic Engineering at the University of Illinois and the Chicago Section of The American Ceramic Society, will be held at Urbana, Illinois, Friday and Saturday, May 10 and 11, 1940.

A program of especial interest to plant operators and glass technologists is being prepared. This program will be announced at a later date and will be forwarded to all who have attended previous sessions. Anyone interested in the Conference who has not attended the meetings is invited to inform the Department to that effect so that his name may be placed on the mailing list.

ST. PAT'S FESTIVAL

The New York State College of Ceramics at Alfred University held its eighth annual St. Pat's Festival on March 14 and 15.

One of the highlights of this festival was the "Open House" on Thursday evening, March 14. At this time, the Ceramic College is thrown open to the public and all phases of ceramic engineering and technology are demon-

strated. The outstanding feature of the Open House was a glassblowing demonstration by skilled craftsmen from the Corning Glass Works, Corning, N. Y.

Members of The American Ceramic Society and other friends of Alfred University are always welcome to attend the festival, especially the "Open House."

—NORMAN KENDALL, *Co-Chairman of Open House*

L. E. BARRINGER AT RUTGERS

Lawrence E. Barringer, General Electric Company, Schenectady, N. Y., was guest speaker at a regular monthly meeting of the Rutgers Ceramic Club and Student Branch of The American Ceramic Society held February 12 at Rutgers University, New Brunswick, N. J.

Mr. Barringer, a prominent figure in the ceramic field, has been active not only in the technological side of the industry but also in the promotion of ceramic art through various organizations. He has also served as president of The American Ceramic Society.

The subject for the lecture was "Ceramic Products in the Field of Electrical Insulation," in which Mr. Barringer reviewed the essential properties of electrical insulators and showed how these vary with conditions of use. He also discussed the various types of ceramic insulators in use, among them the porcelain types for high- and low-tension service and those with steatite-type or pyrophyllite-type bodies. Among the other types covered were the glass insulators, both solid and fibrous, a mica-glass material, and the vitreous enamel. The lecture was followed by a symposium.

—GILBERT GOODMAN, *Corresponding Secretary*

REVIEW OF THE CERAMICS EXTENSION TEXT-BOOKS OF THE PENNSYLVANIA STATE COLLEGE

Ceramics, Volumes I, II, III, by Edward P. McNamara, Supervisor of Ceramics Extension, the Pennsylvania State College; preface by Edward Steidle, Dean, School of Mineral Industries; foreword by H. B. Northrup, Director, Mineral Industries Extension. These three volumes are the textbooks prepared for use by the Ceramics Extension classes throughout Pennsylvania. The first two volumes are used by all of the extension classes during the first two years of the three-year course. For the third year of the course, four terminal options are offered, viz., clay products and whiteware, refractories, glass, and enamels. It is planned to prepare a separate textbook for each of these terminal third-year courses.

Ceramics, Volume III, Clay Products and Whitewares, is the first book completed under this plan. These volumes are supplied to extension students at the prices given. This price also includes the entire cost of the course from the standpoint of the College. Copies of the books are also available to other interested persons at the same price.

Ceramics, Volume I,* General Preparatory Course, 1937, 373 pages, 139 illustrations. Price $2.50. This volume consists of three parts, including mathematics, chemistry, and physics. The part on mathematics consists of chapters on arithmetic, algebra, and geometrical construction; the part on chemistry contains two chapters, one on general inorganic chemistry and the other on the industrial applications of chemistry. The part on physics consists of chapters on general physics, electricity, and mechanics; an appendix includes problem answers.

As the extension course is intended for the practical plant employee rather than for the ceramic engineer or technologist, the first book is elementary and is used as an introductory course to the general fundamental sciences which underlie the various ceramic processes. The fundamentals presented in the various chapters are illustrated by numerous practical examples of plant problems.

* The first printing of this volume has been exhausted and is being revised for reprinting and availability by October 1, 1940.

This book comprises the first year of the regular three-year extension course in ceramics offered by the Division of Mineral Industries Extension.

Ceramics, Volume II, Ceramic Fundamentals, 1938, 359 pages, 148 illustrations, 60 tables. Price $2.50. This book is used as the textbook in the second year of the extension course. The book in general treats of those subjects which are common to all of the ceramic industries regardless of the particular plant product.

The first chapter contains an introduction to ceramics, including the scope of the field and the value and diversity of its products; the remainder is divided into three parts.

Part One deals with ceramic raw materials and includes chapters on mineralogy; occurrence, properties, and uses of the various ceramic raw materials; and raw materials preparation. The chapter on raw materials covers clays, silica, alumina, feldspars, high alumina materials, lime, magnesia and dolomite, the fluorine minerals, the alkali minerals and compounds, the boron minerals and compounds, and graphite and carbon. The chapter on raw-material preparation includes crushing, grinding, screening, tempering, blunging, and mixing.

Part Two deals with heat and includes chapters on pyrometry, fuels and combustion, and refractories for furnaces. The chapter on pyrometry includes a section on the use of cones and that on fuels covers the characteristics and combustion of the various common fuels as well as of the combustion calculations involved; it also includes producer-gas production.

Part Three is silicate chemistry. It contains one chapter on the melting and crystallization of silicates, including the interpretation of phase diagrams. The other chapter contains a collection of fifty-three of the most important equilibrium diagrams applying to ceramic operations.

Ceramics, Volume III, Clay Products and Whitewares, 1939, 526 pages, 194 illustrations, 27 tables. Price $3.50. This is the first of a series of four books to be used in the four optional third-year courses of the extension course. In general, it covers the manufacturing processes peculiar to the clay products and whiteware industries. The book is divided into three parts, the same as Volumes I and II.

Part One is entitled "General Manufacturing Processes." The first chapter presents the four major methods of clay-forming, the soft-mud, stiff-mud, dry-press, and slip-casting methods. Each process is discussed individually and in detail. The discussion includes the preparation and conditioning of clay, a description and operation of the machines and equipment, and the characteristics of the products formed. Chapter II is on drying and driers, including the fundamental theory of drying clay products and a description of the driers and drying systems used in the ceramic industry. Chapter III, "Firing Clay Products," discusses the general theory and the physical and chemical changes accompanying firing. The chapter includes also sections on periodic kilns, car tunnel kilns (by Philip Dressler), and the setting of clayware.

Part Two is on "Calculations and Testing." One chapter includes the ceramic calculations used in compounding clay bodies and glazes. Chapter V includes all of the common standard test procedures for raw materials and fired clay products. Chapter VI covers the equipment used in testing ceramic products and how it is operated.

Part Three consists of Chapters VII, VIII, and IX. Chapter VII includes descriptions and properties of all of the clay products (other than whiteware). The A.S.T.M. and Government specifications of these products are also included. Chapter VIII is similar to Chapter VII, but it deals with the properties of whiteware and the description of their methods of manufacture. Chapters VII and VIII include flow sheets for the production of various clayware. Chapter IX, entitled "Glazes and Colors," includes sections on glaze compositions, raw and fritted glazes, glaze raw materials, glaze preparation, slip making, glaze application, glaze formulas, colored glazes, ceramic colors, and overglaze and underglaze colors.

HARRY B. NORTHRUP

Harry B. Northrup holds the degree of E.M., 1911, from the Ohio State University. Following graduation, he was appointed instructor in metallurgy at the Pennsylvania State College where he served until 1920; he left as acting head of this department in 1920 to enter commercial work. During the World War, he was metallurgist with the Ordnance Department attached to the Bridgeport District Ordnance office.

Harry B. Northrup, Director, Mineral Industries Extension, the Pennsylvania State College

From 1920 to 1925, he was chief metallurgist for the Diamond Chain and Manufacturing Company of Indianapolis, Ind. From 1925 to 1931, he was consulting metallurgist and member of the firm, the J. W. Kelley Co., Cleveland, Ohio, specializing in the carburizing and heat treatment of steel.

He returned to the Pennsylvania State College in 1931 as professor and director of the newly created Division of Mineral Industries Extension. His work in this capacity has been the organization of the department and the preparation of courses of study of a vocational nature for men employed in the basic mineral industries of the Commonwealth.

Through his efforts, fundamental articulated three-year curricula have been prepared, covering the fields of ceramics, coal mining, ferrous metallurgy, natural gas engineering, and petroleum production and refining. These subjects are offered throughout the Commonwealth without cost to the student except for the price of his textbook which is sold to him at a cost of approximately $3.00 annually. This year there are approximately four thousand students enrolled.

EDWARD P. McNAMARA

Edward P. McNamara, supervisor of ceramics extension, received his undergraduate training at Rensselaer Polytechnic Institute and at the New York State College of Ceramics. He pursued graduate work at the Pennsylvania State College, receiving the M.S. degree in Ceramics. Since October 1, 1936, he has been in charge of the Ceramic Extension Department of the Division of Mineral Industries Extension. Previous to that time he was a member of the staff of the Department of Ceramics of the School of Mineral Industries in research and teaching.

The work in ceramics extension was placed on an organized basis in October, 1936, and the first of the three-year courses was offered in the fall of 1937. At the present time there are ten ceramic extension centers operating in various cities in western Pennsylvania. Ten part-time instructors are teaching these classes, and nearly two hundred students are enrolled in the various class centers, all under Mr. McNamara's supervision.

Edward P. McNamara, Supervisor of Ceramics Extension, the Pennsylvania State College

Since 1936, Mr. McNamara has written three textbooks, totaling 1258 pages, to be used by these extension classes. All of the text material used by a class during any one year of the course is contained in one bound volume which is published by the Division of Mineral Industries Extension and furnished to the students at the cost of printing.

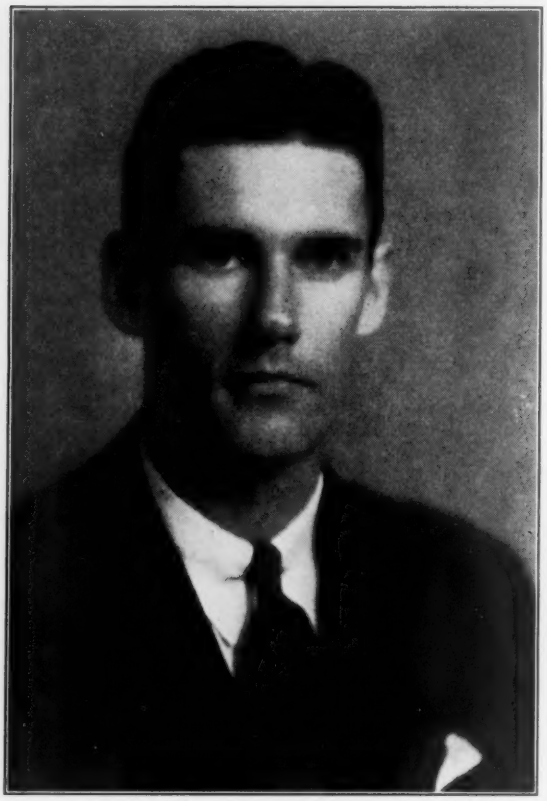
RALSTON RUSSELL, JR.

Ralston Russell, Jr., is serving as Program Chairman for the White Wares Division at the Forty-Second Annual Meeting of The Society.

Dr. Russell was born in Pomeroy, Ohio, November 4, 1910, and attended the public and high schools of that city. From October, 1928, to June, 1933, he attended the Ohio State University, Columbus, Ohio, where he received the degree of Bachelor of Science in Ceramic Engineering in 1932 and the Master of Science degree in 1933. From June, 1933, to January, 1937, he was employed as research and development engineer by the A C Spark Plug Division, General Motors Corporation, Flint, Mich., and from

January to September, 1937, he was ceramic and research engineer for the General Ceramics Company, Keasbey, N. J.

From January, 1937, to February, 1940, Dr. Russell was research engineer and assistant in ceramics at the Ohio State University Engineering Experiment Station in Columbus. During this period, he was enrolled in the Graduate School, and in December, 1939, he received the degree of Doctor of Philosophy. The subject of his dissertation for this degree was "Development of Superduty Refractories from Ohio, Kentucky, and Pennsylvania Fire Clays," which has been published by the Engineering Experiment Station, *Bulletin* No. 105 (1940).



Ralston Russell, Jr.

Dr. Russell is now associated with the Westinghouse Electric & Mfg. Company, Research Laboratories, East Pittsburgh, Pa., as ceramic research engineer.

The following papers have been published by Dr. Russell:

"Effect of Thermal Process on Physical Properties: I, Structural Clay Products," *Bull. Amer. Ceram. Soc.*, **19** [1] 1–12 (1940).

(With A. M. Hossenlopp) "Effect of Furnace Atmosphere and a Partial Vacuum on Vitrification of High Mullite Porcelain," *Jour. Amer. Ceram. Soc.*, **18** [7] 204–205 (1935).

(With J. O. Everhart) "Effect of Atmospheric Exposure on Properties of Unfired Clay Bodies," *ibid.*, **22** [6] 200–203 (1939).

(With A. S. Watts) "Auxiliary Fluxes in Combination with Different Feldspars in an Earthenware Body," *Ceram. Age*, **26** [6] 219–21 (1935); *Ceram. Abs.*, **17** [4] 147 (1938).

(With A. H. Fessler) "Apparatus for Making Ceramic Articles" (General Motors Corp.), U. S. Pat. 2,091,973, September 7, 1937; *Ceram. Abs.*, **16** [11] 346 (1937).

(With A. H. Dierker and J. O. Everhart) "Wearing Properties of Some Metals in Clay Plant Operation: Pug-Mill Knives, Muller Tires, Runner Plates, Screen Plates, and Repress Die Liners," *Ohio State Univ. Eng. Expt. Sta. Bull.*, No. 97, 21 pp. (1937); *Ceram. Abs.*, **17** [8] 286 (1938).

LETTERS FROM THE SECRETARY

WHY CERAMIC GRADUATES SHOULD BE ACTIVE MEMBERS IN THIS SOCIETY*

Anyone who has invested the time and money required to complete a course in ceramics at any university naturally wants to realize the largest possible dividends on his investment. His equity in the education and training which he has received will rapidly dwindle unless he continues to make investments. Education, unlike money, cannot be put in a vault. Indeed it is like a body placed in the grave; it soon crumbles to dust unless activated and kept alive through continued study.

No matter how humble a position a graduate of a school may have when he first enters the industry, he can be sure of retrograding to the status of an employee, pure and simple, or progress to a station of responsibility, depending on whether he discontinues or continues to study.

A young man just leaving a ceramic school has had the training which will enable him to keep posted in all branches of ceramics. This he cannot do alone on a job on which he is employed. The job will not give him opportunities to keep posted broadly and to keep fit to take positions of greater responsibilities and greater remuneration. This continued breadth of training and knowledge can be had only by membership in The American Ceramic Society, and then, only, if he will read and study the reports published.

It seems to be a large waste of time on the part of the boy and of money on the part of the parents if the boy does not continue his ceramic training after he leaves the university.

I know of graduates of ceramic schools who are mere janitors. One five-year graduate told me that his job was to clean up the mill-room floor, separate out the iron, and clean up the frit. This certainly does not require any great amount of thinking, and it certainly does not prepare him for larger employment possibilities.

A group of four who had graduated but two years previously asked me to secure jobs for them in the whiteware industry. You can imagine my surprise when they could not give me the molecular formula for any of the ordinary ceramic materials, the molecular weight of any of the oxides, or name and give proportions of materials that would produce bodies of different characteristics. These four boys had completely lapsed on their ceramic training. I told them that they must hate themselves frightfully to abandon so completely their four-year investment of time and the investment which their parents had made.

You can hang crepe on the door of every ceramic graduate who is not a member of The American Ceramic Society. They are dead as ceramic engineer or ceramic technologist.

* Letter to a ceramic graduate who asked what The Society has to offer to ceramic graduates.

NOTES

BUREAU OF MINES LECTURES

The third lecture of the Bureau of Mines series under the auspices of the University of Maryland for 1939–1940 was presented by Paul M. Tyler on February 27 at the College of Engineering auditorium, College Park, Md. The title of Mr. Tyler's talk was "More Jobs for Minerals."

The fourth lecture of this series will be given the evening of March 26, 1940. The speaker will be Wilbert J. Huff and the title of his lecture, "Some Researches on High Explosives."

FOURTH PORCELAIN ENAMEL FORUM PROCEEDINGS

The Proceedings of the Fourth Annual Forum of the Porcelain Enamel Institute contains all the papers delivered at the meetings held at Ohio State University in October, 1939, as well as a verbatim report of the discussions which followed each paper.

The most recent technical improvement in the enameling process, fine grinding, is given important consideration in the report. Prominent technical men from the industry and the schools participated, and additional pertinent information on this subject is brought out in the papers and bulletins on the grinding process.

Cast-iron enameling by the dry-process method is covered in a complete report of the development of a new approach to certain old manufacturing problems. The accompanying symposium includes the ideas of the best enamelers in this branch of the trade.

The work being done at the National Bureau of Standards is considered in the papers on chipping resistance and on the development of standard tests.

Metal drawing and cleaning are the subjects of papers dealing with drawing compounds and the use of softened water in the cleaning and pickling process.

The chapters and discussions of architectural enameling bring out new ideas of those interested in this field. They discuss the favorable and unfavorable aspects of this promising field.

Certain general subjects, which have been given serious consideration by managements, are covered in the discussions of health hazards in pickling and in the report on inspection and packing problems. The proper use of fuel oil is presented by an expert from the oil industry.

As the Forum attracts the best operating men from the industry, this publication will be of interest to all suppliers of materials and to all manufacturers of porcelain enamel.

Copies of the Proceedings may be obtained at $2.00 each from the Porcelain Enamel Institute, 612 North Michigan Avenue, Chicago, Ill. With each order, upon request, copies of the Proceedings of the First, Second, and Third Forums will be included at $1.00 for the set of three.

PORCELAIN ENAMEL INSTITUTE

The Fifth Annual Forum of the Porcelain Enamel Institute will be held at the University of Illinois, Urbana, Ill., on October 16, 17, and 18, 1940, according to an announcement by Frank E. Hodek, Jr., General Porcelain Enameling & Manufacturing Company, chairman of the Forum Committee.

O. HOMMEL ADDRESSES EASTERN ENAMELERS

At a meeting of the Eastern Enamelers Club, held on February 17 at the Benjamin Franklin Hotel, Philadelphia, Pa., Oscar Hommel, president of the O. Hommel Co., of Pittsburgh, gave a talk on "Fifty Years of Growth in the Enameling Industry." Mr. Hommel reviewed the numerous enamel developments that have taken place during his fifty years of serving the ceramic industry, and he discussed materials, formulas, processes, decorations, and porcelain enamel markets.

He paid special tribute to the steel industry for the progressive strides in the development of a suitable enameling steel for speedier porcelain production.

In discussing the handicaps the pioneer American enameler had to overcome before a satisfactory piece of ware could be produced, Mr. Hommel said: "The formulas of those days were of German, Belgian, or English origin. The enameler had no knowledge of the science and chemistry of the materials with which he worked. There were no textbooks or technical schools where this knowledge could be acquired. Ware was shoveled into a coal-burning furnace with large hay forks, and the use of such modern equipment as pickle baskets, spray guns, driers, pyrometers, and other modern control apparatus was unknown. Enameled ware that may be purchased today for ten cents would cost one dollar to manufacture in the earlier days."

Mr. Hommel, in conclusion, pointed out the many new markets now open to porcelain enamel, and he optimistically hoped that the next fifty years would far surpass the developments of the last half century.

—A. J. MITTELHAUSER

CERAMIC ARCHAEOLOGY STUDIES

Members of The Society will be interested in a letter dated February 13, 1940, in which Frederick R. Matson sends an application to rejoin The American Ceramic Society. Dr. Matson is with the Ceramic Repository for the Eastern United States, established under the auspices of the National Research Council and administered by the Museum of Anthropology at the University of Michigan, University Museums Building, Ann Arbor, Mich.

"It gives me a great deal of pleasure to write this letter, for at last I am able to rejoin The American Ceramic Society after an absence of six years. During that time I have read the *Journal* and *Bulletin* at the library, so I have not been completely out of touch with some of the more recent developments.

"My work is of rather a hybrid nature, combining training in ceramic engineering with archaeology. After getting my Ph.D. in Ceramic Archaeology, I obtained a staff appointment at Michigan in the Museum of Anthropology as Assistant Curator of Ceramics, and here have a laboratory that I am gradually equipping for ceramic studies. So far I have an electric kiln with atmosphere control, a petrographic miscroscope with auxiliary equipment, and an Ainsworth chainomatic balance as well as the usual minor items. I am making technological studies of ancient ceramic ware, trying to determine the manner of their manufacture and to recognize mineralogically the imported ware that may occur at a site. Eventually I hope to trace the technological development of the potter's craft in antiquity.

"Enclosed is my check for $12.75. The extra 25 cents is for a copy of the Bibliography of Ceramic Microscopy which Dr. McVay writes me is available at that price."

NATIONAL SCULPTURE SOCIETY FESTIVAL

A Sculpture Festival, under the auspices of the National Sculpture Society, will be held at the Whitney Museum of American Art, 10 West 8th St., New York, N. Y., April 2 to May 3, 1940. The Exhibition will consist of monumental, decorative, and architectural sculpture, medals and portraits, ceramics, terra cotta, small groups of figures for home decoration, photographs of executed monuments, interesting sketches of projects, and drawings by sculptors.

Original works by living American artists in media such as marble, stone, cast stone, metal, wood, terra cotta, ceramics, and plaster will be exhibited.

The only day for the reception of exhibits is Wednesday, March 20, but by special arrangement with the Committee, large pieces of sculpture may be delivered on March 21.

The members of the Jury of Selection are Paul Manship, *Chairman;* John Gregory, Gaetano Cecere, Brenda Putnam, A. A. Weinman, Ulrich H. Ellerhusen, Wheeler Williams, Lee Lawrie, and Henry Kreis.

The headquarters of the National Sculpture Society are 115 East 40th St., New York, N. Y.

Membership in
The American Ceramic Society
FOR CONTINUING EDUCATION IN CERAMICS

RULES FOR PRESENTATION AND PREPARATION OF PAPERS AT TECHNICAL SESSIONS OF THE AMERICAN CERAMIC SOCIETY*

I. General Information

(1) Listing of Papers

The papers on the Division Programs will be called in the listed order. Except at the discretion of the presiding officer, the order will not be altered. Papers called without response will automatically go to the end of the list where they may be called if time permits. Titles submitted too late to appear on the program will be announced at the opening of the Meeting and will be given a place at the end of the regular program.

Papers listed by authors who are not present at the Meeting will not be read unless those present express by vote their wish to hear them.

Written discussions are desired and invited; if made known, they may be given before extemporaneous oral discussions.

(2) Presentation of Papers

Careful preparation of papers and attention to the manner of presentation are as necessary to the speaker facing a technical audience as they are to the lawyer pleading at court.

Authors, except specially invited lecturers, are expected to present their papers in 15 minutes. Where the text is long or the mass of data is too great to permit this, the paper should be abstracted and only the salient points presented in order to keep within this limit. The chairman may extend the time of a speaker on vote of those present.

A careful selection and summarization should be made of the most important parts of each paper. This should include not more than one thousand words and should be less for slow speakers. While undue haste will lessen the effectiveness of the speaker, lengthy pauses, owing to unfamiliarity with the speech, are a waste of time and are extremely trying to the listeners.

There are four ways to deliver an address, viz.,

(*A*) *Reading from Manuscript:* Reading with the eyes almost constantly on the manuscript is emphatically condemned. This method will not hold the attention of the audience.

(*B*) *Speaking from Notes:* Speaking from notes is less disturbing to the listeners than reading from the completed manuscript.

(*C*) *Speaking Memoritor:* A thoroughly well-memorized speech can be successful if learned so well that the speaker is not haunted by fear of forgetting so that when speaking he can realize the full significance of what he is saying.

(*D*) *Speaking Extempore:* This is the most effective method of delivering a speech. It demands most thorough preparation. The speaker should write and rewrite the address several times and then read it aloud at least twenty times, each time trying to convey the meaning to an imaginary audience. Afterward, he should speak it aloud without the manuscript many times, making no attempt to memorize it verbatim, but leaving the choice of words to the occasion. If he is inexperienced, it is always an aid to confidence to memorize the introduction and conclusion.

Speakers are urged to use medium-sized filing cards that can be held in one hand leaving the other free for motion. Cards should not be written on both sides, and one idea only should be written on each card.

When the Chairman has introduced the speaker to the meeting, some person in the last row of the audience should be selected and addressed, slowly, distinctly, and loud enough so that he can hear at all times. When showing slides, this person should be addressed. Do not talk to the screen.

(3) Lantern Slides

The slides should be of the standard size used in the United States, i.e., $3^1/_4$ by 4 inches. The lettering should be of such size as to be easily read at a distance from the screen.

(4) Preprinting of Papers and Committee Reports

The Committee on Publications will have the available papers and committee reports to be presented at Annual Meetings in printed form at the Meeting. To render this practicable, the manuscripts should be sent to the Editor at least two months in advance of the Meeting at which they are to be presented. It is manifest, however, that if all papers forming part of a comprehensive program should be received only two months in advance of the Meeting, it would not be possible to have them all in type in a single month. Authors and chairmen of committees are accordingly requested to furnish their manuscripts as far in advance of the Meeting as possible.

In general, the sequence in which the papers are received will determine the sequence in which they will be preprinted.

(5) Discussions

All written discussions shall be placed in the hands of the Division Chairman prior to the session at which they are to be presented. Such written discussions shall take precedence over oral discussions. In the presentation of written or oral discussions, the speaker, in general, will be limited to five minutes, but this time may be extended at the discretion of the chair or by vote of the meeting.

(6) Publication in the Technical Press

No paper, committee report, or written discussion shall be released for publication in the daily or technical press in advance of its presentation, except by authority of the Committee on Publications, or after its presentation unless it has previously been edited by the Committee or the Committee agrees to release it without editing.

II. Division Editorial Committee Procedure

(1) Committee Personnel

Each Committee shall consist of three members chosen by their Division officers and members. One of the three persons named shall be appointed chairman of the Committee.

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* Adopted by the Committee on Publications, The American Ceramic Society, 1932.

(2) Procedure

(*A*) *Editor's Work:* The paper usually is first edited by the Editor of the *Journal* in such manner as he should judge best suited for publication purposes. If the paper is cut and written over to a great extent, the author's original copy should also be submitted with the revised copy to the Committee. This enables the Committee to judge the value of the Editor's suggestions and to restore portions if they are agreed on such action.

(*B*) *Committee Procedure:* (1) The paper is forwarded to the Chairman of the Division Committee under whose supervision the paper falls. After checking the paper, the Chairman forwards the paper to the second member of the Committee together with his comments.

(2) The second member of the Committee, after reviewing the paper, makes his suggestions and forwards the material to the third member of the Committee.

(3) The third member of the Committee reviews the paper and returns the material with his comments to the Chairman.

(4) The Chairman makes a summary of the accumulated suggestions and returns the paper to the Editor.

(5) If the Committee disagrees with statements of the author but considers the fundamental work worthy of publication, the paper, with these comments, is returned by the Editor to the author, with the recommendation that he clear up the points in question.

(6) If the paper does not seem to fit in with the standard quality for the *Journal* or for *The Bulletin*, it is returned to the author so that he may submit it elsewhere for publication. In case of disagreement, the paper becomes the property of the author.

III. Important Constitutional Provision

Article X. Publications

The rejection of papers will be determined chiefly on the following grounds:

(1) The subject matter does not fall within the field of The Society's activities.
(2) The paper contains matter readily found elsewhere.
(3) The contents are of an advertising character.
(4) The author controverts well-established facts.
(5) The subject matter is not new.
(6) The subject matter is essentially of a speculative nature.
(7) The treatment is seriously defective as to literary form and structure, continuity of thought, clarity of expression, etc.

NOTE: The Publications Committee has adopted a rule for its own procedure that (1) no paper or report will be published by The Society that will appear elsewhere in English except as a reprint from the publications of The Society; and (2) officers of Divisions may, at their own discretion, accept for Meeting programs papers and reports subject to reservation of publication rights by the author.

The Committee on Publications shall determine which papers shall be printed. The Committee may return a paper to the writer for change or correction and may call to its aid one or more members of special experience relating to the subject treated, either to advise on the paper or to discuss it.

(1940)

(1) Important Notice

All papers, discussions, and other writings which have been presented before The Society, its Divisions, or Sections, and all committee reports shall become the property of The Society. Their publication or other disposition shall be in the hands of the Committee on Publications.

IV. Suggestions to Authors for Preparation of Papers

(1) General

(*A*) *Form:* Papers should be submitted typewritten in *double or triple space* to permit mechanical editing for the printer. White paper, $8^1/_2$ by 11 inches, should be used and the *original copy* should be sent to the Editor. (Do not submit *carbon copies*.)

(*B*) *Abstract:* An abstract statement of the procedure and conclusions of the problem of the paper should be submitted with the manuscript. The length of this abstract will depend on the subject matter of the paper. All of the important results should be included in the abstract. Ordinarily one hundred words are sufficient for this statement.

(2) Footnote References

All footnote references should be in *double or triple space* to permit editing for the printer.

The first reference is an asterisk (*) stating where the paper was presented and the date of its receipt in the Society offices.

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EXAMPLE: (1) Hewitt Wilson, Ceramics, Clay Technology, pp. 232–34. McGraw-Hill Book Co., Inc., New York, 1927.
(2) F. A. Kirkpatrick and W. E. Williams, "A Cone Nine Vitrified Floor Tile Body," *Jour. Amer. Ceram. Soc.*, **15** [1] 28–33 (1932).

For abbreviations of periodicals, the style is the same as that in *Ceramic Abstracts*.

References to patents should include patentee, assignee, name of patent (or title), patent number, and issue date.

EXAMPLE: A. N. Cramer (Owens-Illinois Glass Co.), Glassware Annealing Leer, U. S. Patent 1,854,452, April 19, 1932.

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EXAMPLE

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(1) Zigzag Welded Winding (*side-flush heading, bold-face type*)

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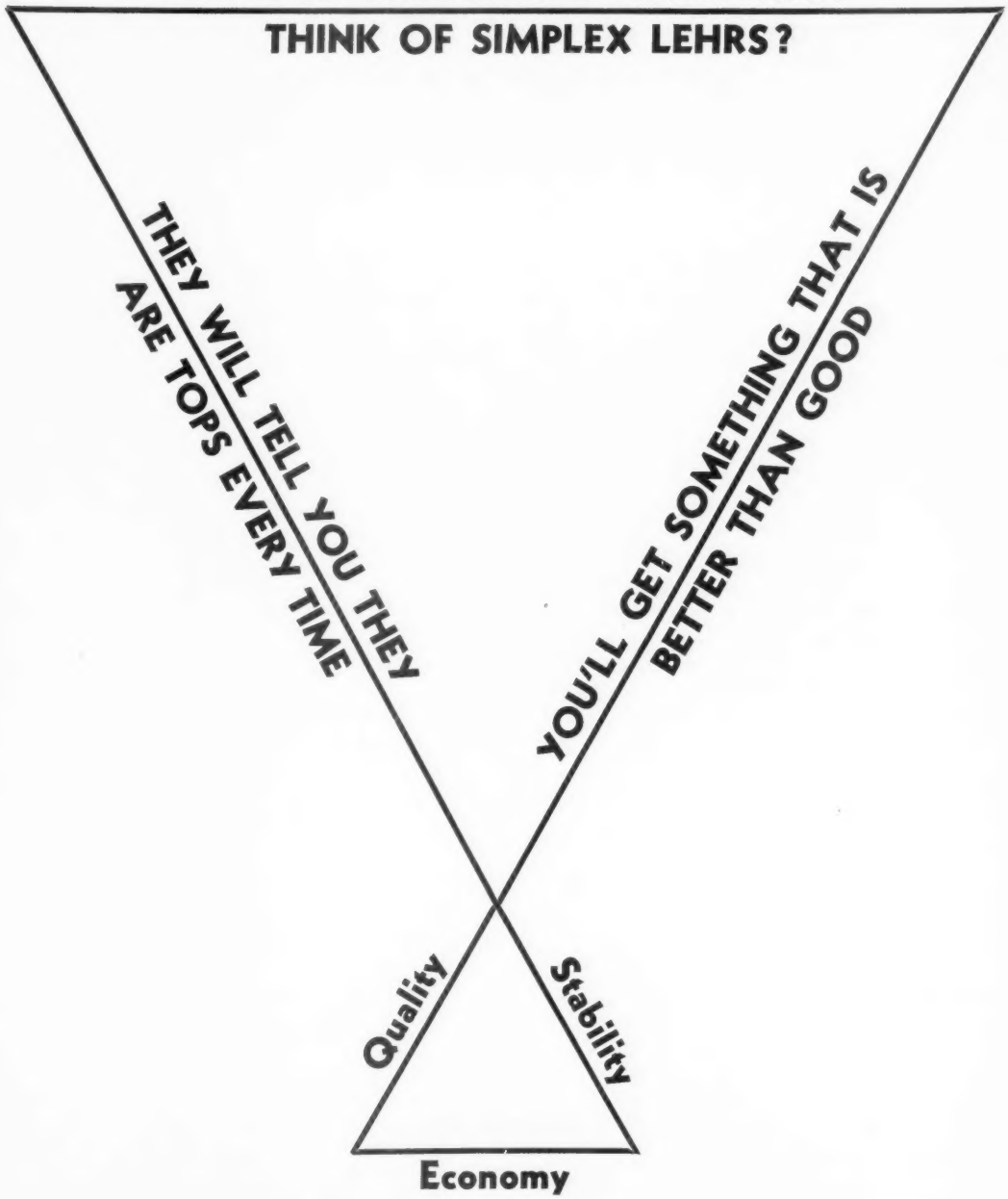

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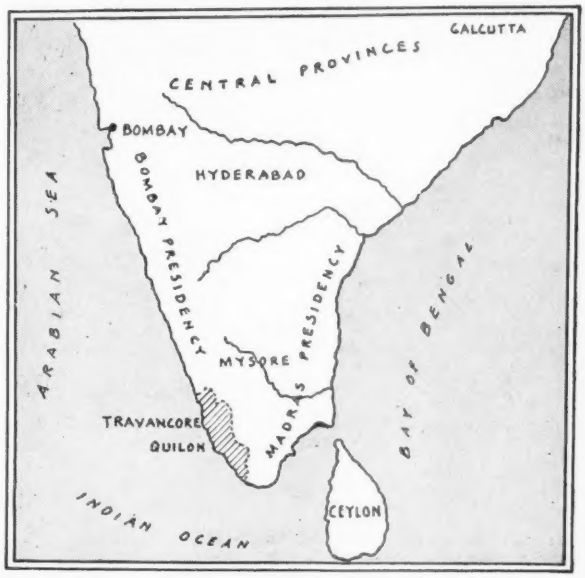

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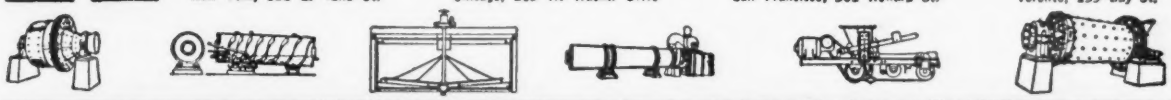

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	Titanium oxide (TiO_2)	1.29
	Ferric oxide (Fe_2O_3)	0.55
	Lime (CaO)	0.00
	Magnesia (MgO)	0.00
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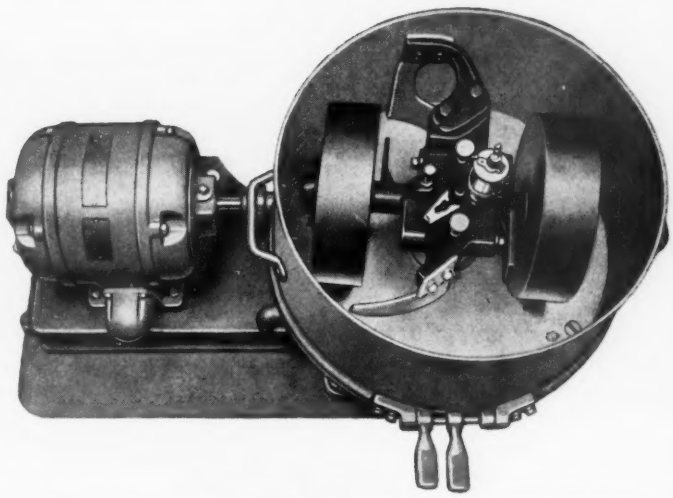

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